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NRL Memorandum Report 1635

Field Strengths of Some VLF Transmissions and Atmospheric Noise Measured in Asia June 1963 Through March 1964

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Radio Division

July 13, 1965

U.S. NAVAL RESEARCH LABORATORY
Washington, D.C.

CONFIDENTIAL

CONTENTS

ABSTRACT
(Confidential)

The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. The statistical relationship of the field strength of various VLF transmissions and atmospheric noise and the signal-to-noise ratios with the time of day and season of the year is being investigated. Between December 1958 and March 1964 the subject propagation data was recorded at the following sites: Hammerfest, Bodø and Varhaug, Norway; Rome, Italy; Haifa, Israel; and Karachi, West Pakistan.

This is the fifteenth and last in a series of quarterly reports, covering the nineteenth through the twenty-second quarters since the program began. The only station in operation during this period was Karachi, which was closed about the first of April, 1964.

AUTHORIZATION

NRL Problem F01-39
BUSHIPS Problem S-1888
SR 008-01-01-7028

FIELD STRENGTHS OF SOME VLF TRANSMISSIONS AND ATMOSPHERIC NOISE MEASURED IN ASIA JUNE, 1963 THROUGH MARCH, 1964

INTRODUCTION

The Naval Research Laboratory is conducting an investigation of very-low-frequency (VLF) radio wave propagation at great distances and over a long period of time. For this investigation, the field strengths of various VLF transmissions and atmospheric noise were continuously recorded at several sites on the coasts of Europe and the Near East from December 1958 through March 1964. Extension of the project to the spring of 1964 was primarily intended for obtaining coverage data on the Navy's VLF transmitting facility at Cutler, Maine which commenced operation in January 1961.

The routine output data was published in installments covering each quarter of the year, grouped according to the seasons. This series of reports did not contain an analysis of the data. Analysis and correlation of the data with various geophysical phenomena will be the subject of other reports. This is the fifteenth and last in the series of these installments and covers the nineteenth through the twenty-second quarters, June, 1963 through March, 1964 when the Karachi station was closed. References 1 and 2 covered two and four quarters, respectively.

TRANSMISSION PATHS

During the period covered in this report, field strengths of VLF transmissions and atmospheric noise were recorded at Karachi, Pakistan. The precise location of this, and all other recording sites, is given in Table 1. The locations of the U. S. Navy VLF transmitters are given in Table 2.

TABLE I

Locations of Data Recording Stations and Periods of Operation

Station	Location		Period of Operation
	Latitude	Longitude	
Bodø	67° 16.5'N	14° 21.4'E	Dec 1958 - Sep 1960
Varhaug	58° 37.5'N	5° 37.8'E	Dec 1958 - Mar 1962
Rome	41° 51' N	12° 40' E	Dec 1958 - Aug 1960
Hammerfest	70° 39' N	23° 37' E	Jun 1959 - Dec 1959 Mar 1961 - Mar 1963
Haifa	32° 48' N	35° 2' E	Jun 1959 - May 1962
Karachi	24° 54' N	67° 2' E	Jun 1961 - Mar 1964

TABLE 2

Locations of U. S. Navy VLF Transmitters

Station Call Letters	Location	
	Latitude	Longitude
NSS	38° 59.1'N	76° 27.2'W
NPG	48° 12' N	121° 55' W
NPM	21° 25.5'N	158° 9.7'W
NDT	34° 58.3'N	137° 1.3'E
NAA	44° 38.9'N	67° 16.9'W
NBA	9° 3.3'N	70° 38.9'W

DATA RECORDING AND PROCESSING METHODS

All field strength data reported herein were recorded using a 10-foot, vertical, monopole (whip) antenna. One such antenna is installed at each data recording station. A broadband antenna coupler is used to couple the antenna to AN/URM-139 and AN/URM-6 field strength meters which drive Esterline-Angus strip chart recorders. The whip antenna system is calibrated periodically using a loop antenna.

The U. S. Navy transmitters "locked key" for three minutes and, immediately preceding or following, are "off" for three minutes once each hour. It is during these periods that the subject data were recorded.

Atmospheric noise

The atmospheric noise field strengths reported are average values recorded once each hour during the three minute "off" period of the transmitters discussed above. The AN/URM-139 equipments have a nominal noise bandwidth of 41 cps while the noise bandwidth of the AN/URM-6 equipment varies between about 100 and 200 cps depending upon the frequency to which it is tuned. All atmospheric noise field strengths have been normalized to a bandwidth of 100 cps.

Signal Field Strengths

The signal field strengths given in this report are average values over the three minute "locked key" period recorded once each hour, and normalized to a radiated power of one kilowatt. The signal field strengths are calculated from the measurements of the average signal plus noise and the average noise made during the locked-key and off periods of the transmitters. The radiated power during each locked-key period is determined from a measurement of the average transmitting antenna current during each period and the average radiation resistance of the antenna. The radiation resistance values used for each transmitter are given in Table 3. The radiation resistance of each transmitting station is periodically measured and the value appropriately changed if necessary. Although the radiation resistance of NPG appears to have a seasonal dependency, an average value is used throughout

the year since the effect on the radiated power is slight.

TABLE 3

AVERAGE RADIATION RESISTANCE FOR VLF TRANSMITTERS

Station	Frequency kc	Radiation Resistance ohms
NAA	14.7	0.078
*NAA	18.6	0.121
NBA	18.0	0.069
NPG	18.6	0.079
*NPG	24.0	0.149
NPM	19.8	0.072
NSS	22.3	0.134

*Frequency changes were made in August, 1963.

Signal-to-Noise Ratios

The signal to atmospheric noise ratios for each hourly locked-key and off period reported are the ratios of the locked-key field strengths normalized to a radiated power of one kilowatt, to the average atmospheric noise field strengths normalized to a 100 cps bandwidth.

Transmitter Radiated Power

As previously stated, the field strengths of all transmissions reported herein have been normalized to a radiated power of one kilowatt. The radiated power during each field strength measurement is calculated by squaring the average transmitting antenna current measured during each locked-key period and multiplying by the average value of radiation resistance (Table 3). To determine the various propagation effects, it is necessary to normalize the data to a constant radiated power. However, for planning communication circuits

and determining the reliability of the circuits, it is necessary to know the radiated power capability of each transmitting facility.

In Table 4 the average radiated power for each transmitter for each month is given along with the number of hourly periods during which the locked-key test was not transmitted. For approximately six hours each week, NPG operates with only half of its transmitting system for routine maintenance. Although these periods have been referred to as "half-power" transmissions, the reduction in radiated power during such operation is considerably more than 3 db. These "half-system" transmitting periods were not used in determining the average radiated power from NPG because normally the signal is undetectable at all the data recording stations during these periods. The NAA transmitter also operates periodically from half of the system at a reduction in radiated power of approximately 3db. Since these "half power" transmissions can be received at all of the data recording stations, they are not omitted in computing the monthly average radiated power, as is the case with NPG. In Table 4 the monthly average radiated power is computed separately for the full and "half power" transmissions.

TABLE 4

MONTHLY AVERAGE RADIATED POWER

STATION	FREQ KC	MONTH YEAR	AVERAGE RADIATED POWER KW*		DB ABOVE 1 KW*		NUMBER OF LOCKED-KEY PERIODS FULL POWER	HALF POWER	OMITTED
NAA	14.7	Jun 63	901.4	408.5	29.5	26.1	564	110	46
	14.7	Jul	901.3	413.4	29.5	26.2	561	57	126
	18.6	Aug	817.7	391.9	29.1	25.9	66	533	145
		Sep	818.0	392.2	29.1	25.9	323	68	329
		Oct	818.0	385.2	29.1	25.9	14	323	407
		Nov		391.9		25.9	0	344	376
		Dec	747.5	392.5	28.7	25.9	289	63	392
		Jan 64	750.2	390.0	28.8	25.9	327	32	395
		Feb	818.0	392.0	29.1	25.9	386	36	374
		Mar	818.2	387.9	29.1	25.9	303	48	393
NBA	18.0	Dec 63	16.4		12.2		579	0	165
		Mar 64	16.4		12.2		669	0	75
NPG	24.0	Dec 63	226.7		23.5		593	4	147
		Jan 64	221.1		23.4		562	4	178

* First Column Indicates Average Power During Full Power Locked Keys
Second Column Indicates Average Power During Half Power Locked Keys

RESULTS

The data are reported in several forms as follows:

1. The mean plus and minus one standard deviation for the signal and the atmospheric noise field strengths and the signal-to-noise ratios for each hour of one day for a period of one month.

2. The mean for the signal field strengths and the signal-to-noise ratios for each hour of the day over approximately ten day periods of each month.

3. The probability distribution of the signal and the atmospheric noise field strengths and the signal-to-noise ratios for a period of one month.

NOTE: The probability distribution presented in the signal and noise data, separately, are not time correlated. That is, a high signal level did not necessarily occur simultaneously with a high noise level. Therefore, these two sets of data cannot be used for determining the signal-to-noise probability distribution. Graphs showing the true, signal-to-noise probability distribution are presented, however.

In processing the data included in this report, atmospheric noise field strengths are computed only for the hours during which a signal field strength is computed from a recorded locked key transmission. Ideally this occurs once an hour, every hour. Priority traffic and scheduled maintenance at the transmitter and emergency maintenance at the transmitting and receiving sties thwart efforts to attain the ideal situation. The actual number of recorded, locked key transmissions is indicated above each hourly plot on the monthly signal-to-noise ratio curves. These numbers apply to the signal and atmospheric noise field strengths as well as the signal-to-noise ratio calculations.

During the period covered by this report, only the NAA transmissions provided sufficient data each month to warrant reporting. As was indicated in Table 3, NAA and NPG made frequency shifts in August, 1963. NAA went from 14.7 kc to 18.6 kc and NPG from 18.6 kc to 24.0 kc. No NPG 18.6 kc data is reported herein.

Additional information about atmospheric noise at many locations around the world and for the same period covered by this report may be found in references 4, 5, and 6.

Figures 1 and 2 may be removed from the report and used for interpolation of the appropriate graph scales.

In March 1962 new antenna couplers were installed at the Hammerfest and Karachi sites. The method used for determining the antenna factor with the new coupler was different than the method used with the old coupler by a factor of 6 db. Unfortunately this change was not incorporated in the computer program. As a consequence, all of the signal and noise field strengths from those stations are in error from that date. The correction factors are noted on the affected curves. The signal-to-noise ratio curves are, obviously, not affected. This had previously been reported in reference 3.

TABLE 5

FIGURE NUMBER INDEX OF THE INCLUDED DATA

	NAA 14.7 kc	NAA 18.6 kc	NBA 18.0 kc	NPG 24.0 kc
June, 1963	3 - 9			
July	10 - 16			
August		17 - 23		
September		24 - 30		
October		31 - 37		
November		38 - 44		
December		45 - 51	52 - 58	59 - 65
January, 1964		66 - 72		73 - 79
February		80 - 86		
March		87 - 93	94 - 98	

REFERENCES

1. NRL Memo Report 1478 - 5 December 1963, by W. E. Garner, F. J. Rhoads, E. J. Elwood, III and R. L. Schauer.

2. NRL Memo Report 1595 - 2 March 1965, by W. E. Garner, F. J. Rhoads, R. L. Schauer.

3. NRL Memo Report 1571 - 29 October 1964, by W. E. Garner, F. J. Rhoads, and R. L. Schauer.

4. "Quarterly Radio Noise Data - June, July August, 1963" by W. Q. Crichlow, R. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 18-19 dated 21 August 1964.

5. "Quarterly Radio Noise Data - September, October, November, 1963" by W. Q. Crichlow, R. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 18-20 dated 23 October 1964.

6. "Quarterly Radio Noise Data - December, January, Fedbuary, 1963-64" by W. Q. Crichlow, R. T. Disney, and M. A. Jenkins, National Bureau of Standards Technical Note No. 18-21 dated 25 January 1965.

NORMALIZATIONS

The Field Strengths Of All Transmissions Are Normalized To A Radiated Power (P_r) Of One Kilowatt.

Atmospheric Noise Field Strengths Are Normalized To A Bandwidth of 100 Cycles Per Second.

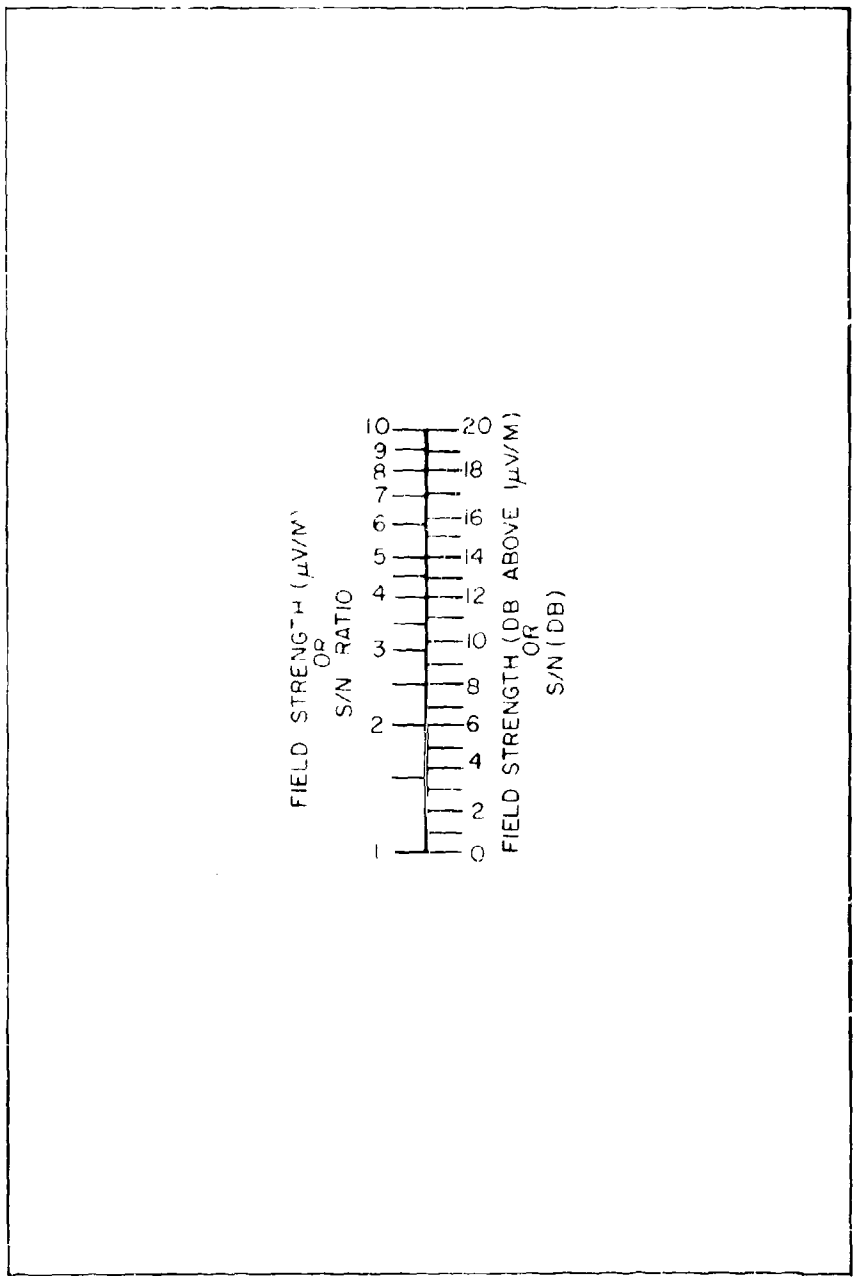

FIELD STRENGTH (µV/M)
OR
S/N RATIO
10
9
8
7
6
5
4
3
2
1
20
18
16
14
12
10
8
6
4
2
0
FIELD STRENGTH (DB ABOVE 1µV/M)
OR
S/N (DB)

Figure 1

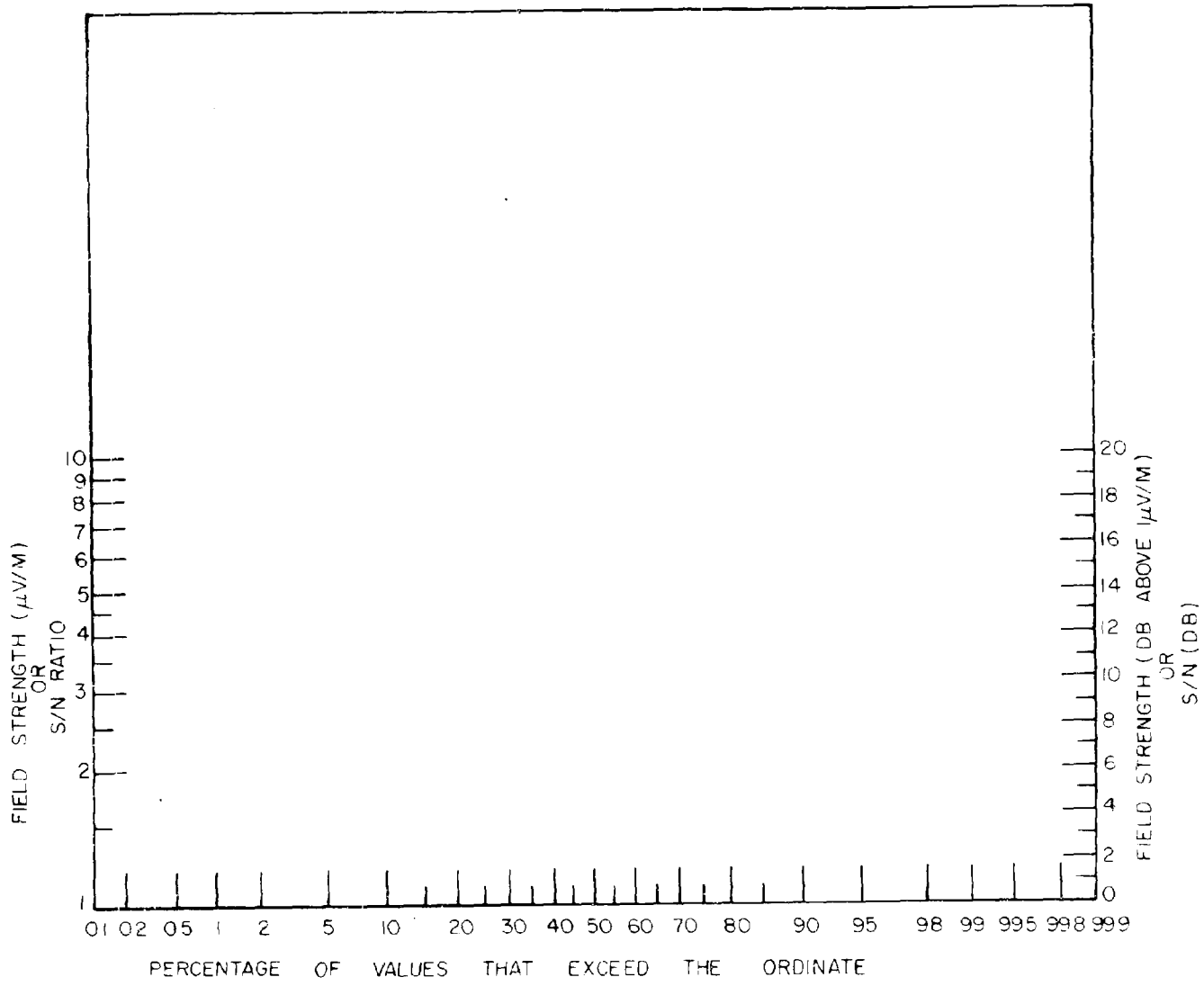

FIELD STRENGTH (μV/M)
OR
S/N RATIO
1
2
3
4
5
6
7
8
9
10
FIELD STRENGTH (DB ABOVE 1μV/M)
OR
S/N (DB)
0
2
4
6
8
10
12
14
16
18
20
01 02 05 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 995 998 999
PERCENTAGE OF VALUES THAT EXCEED THE ORDINATE

Figure 2

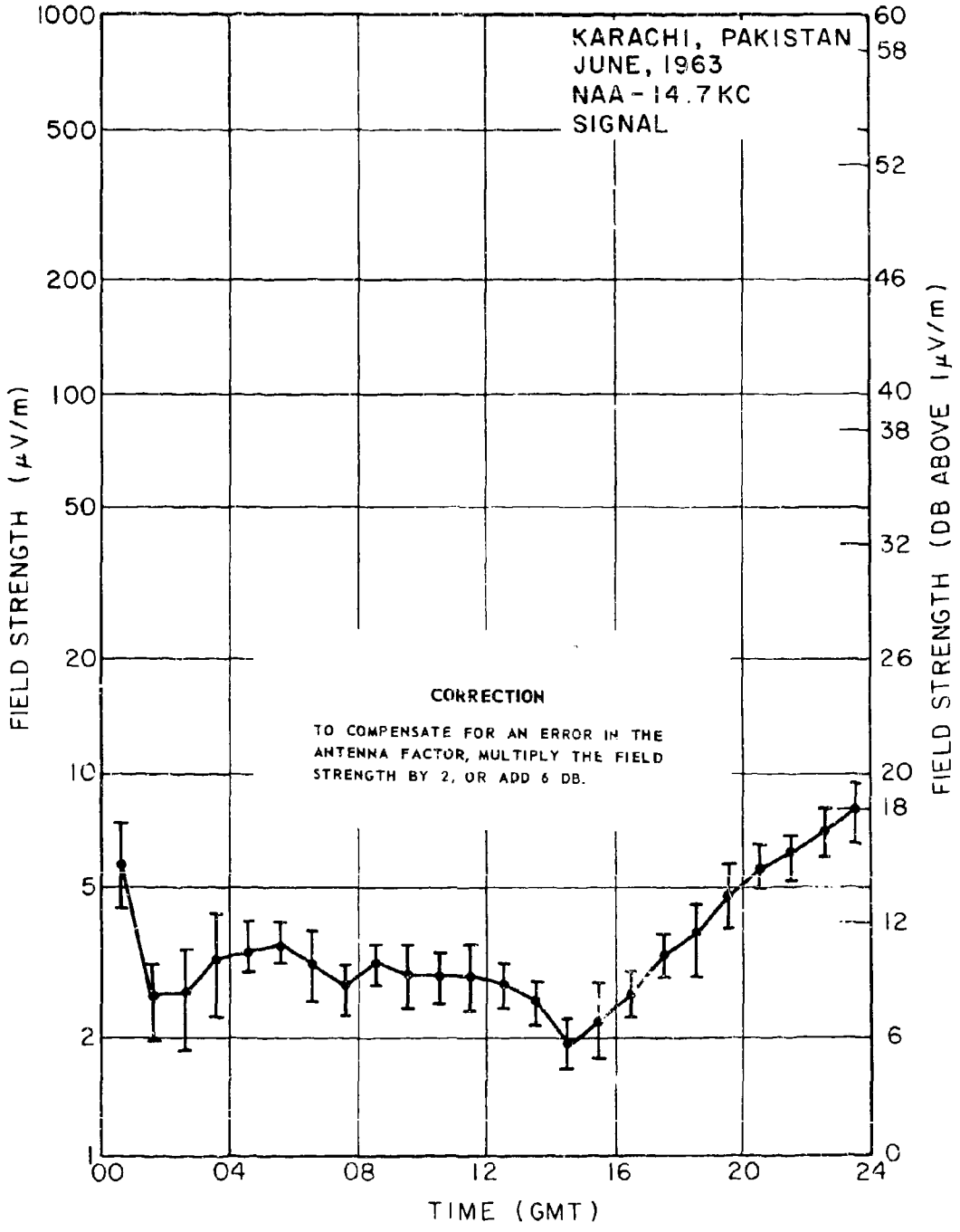

KARACHI, PAKISTAN
JUNE, 1963
NAA - 14.7 KC
SIGNAL
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
1000
500
200
100
50
20
10
5
2
1
60
58
52
46
40
38
32
26
20
18
12
6
0
00
04
08
12
16
20
24
TIME (GMT)

Figure 3

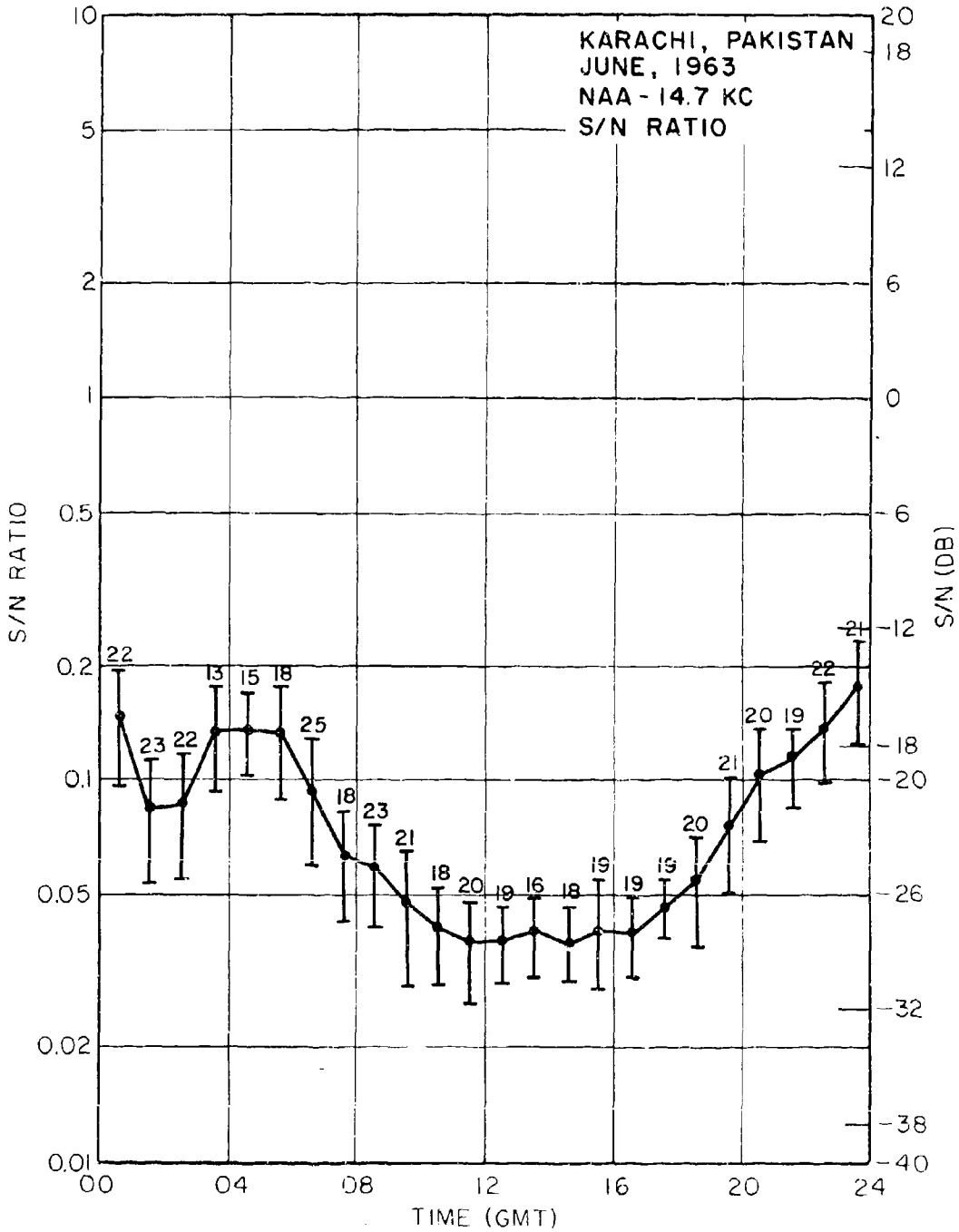

KARACHI, PAKISTAN
JUNE, 1963
NAA - 14.7 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
22
23
22
13
15
18
25
18
23
21
18
20
19
16
18
19
19
19
20
21
20
19
22
21

Figure 4

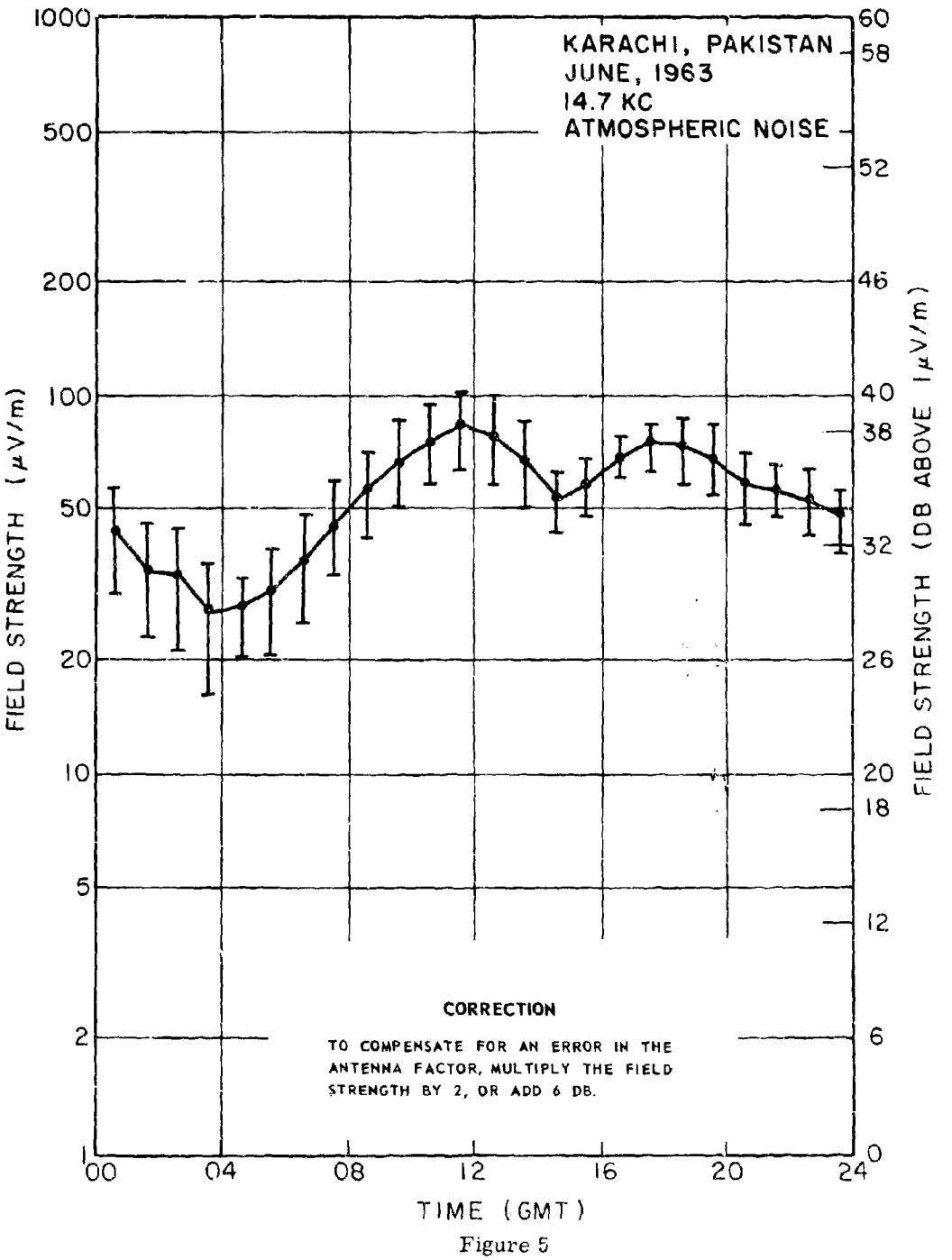

KARACHI, PAKISTAN
JUNE, 1963
14.7 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
1000
500
200
100
50
20
10
5
2
1
60
58
52
46
40
38
32
26
20
18
12
6
0
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
00
04
08
12
16
20
24
TIME (GMT)

Figure 5

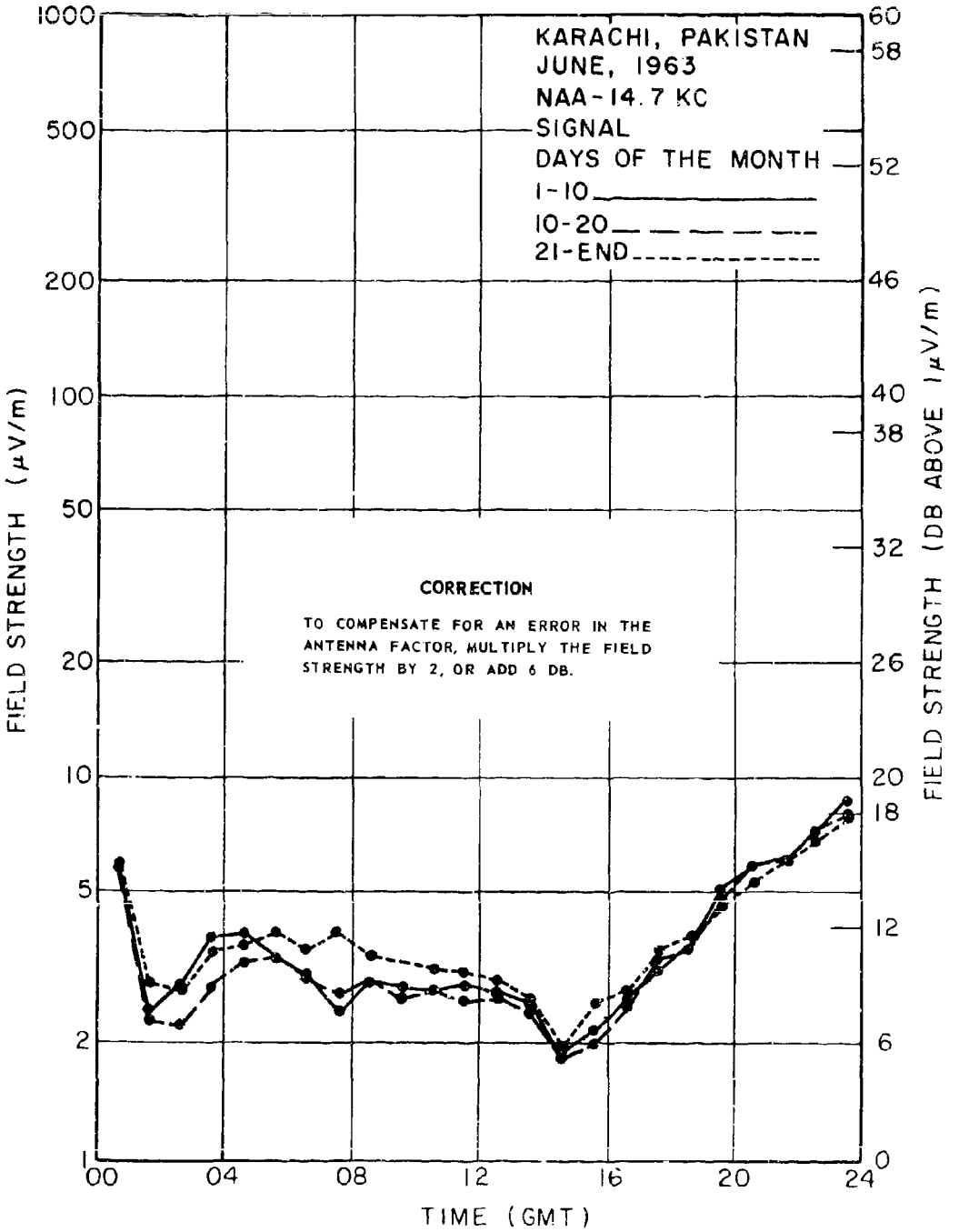

KARACHI, PAKISTAN
JUNE, 1963
NAA - 14.7 KC
SIGNAL
DAYS OF THE MONTH
1-10
10-20
21-END
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
1000
500
200
100
50
20
10
5
2
1
60
58
52
46
40
38
32
26
20
18
12
6
0
00
04
08
12
16
20
24
TIME (GMT)

Figure 6

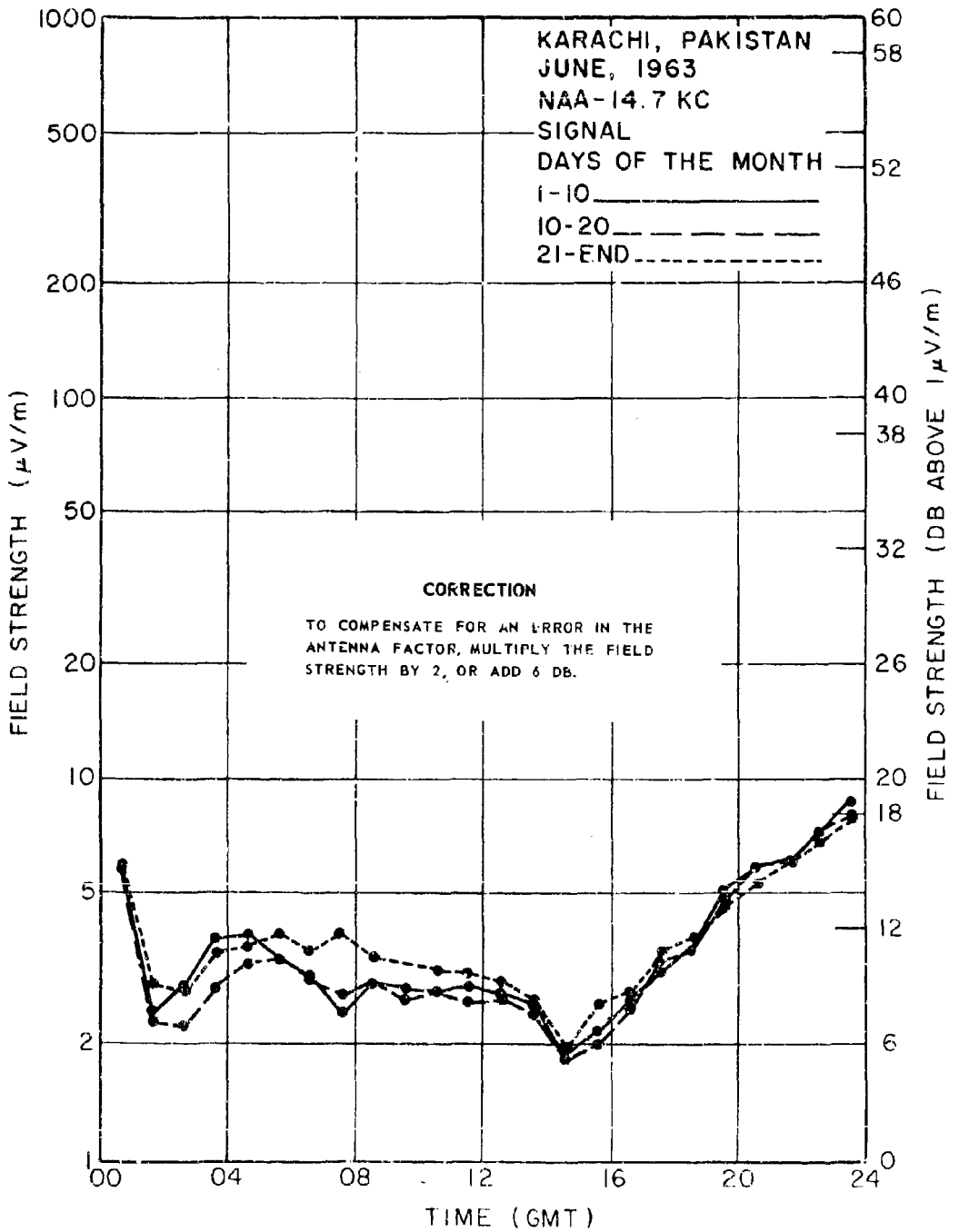

KARACHI, PAKISTAN
JUNE, 1963
NAA-14.7 KC
SIGNAL
DAYS OF THE MONTH
1-10
10-20
21-END
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
1000
500
200
100
50
20
10
5
2
1
60
58
52
46
40
38
32
26
20
18
12
6
0
00
04
08
12
16
20
24

Figure 6

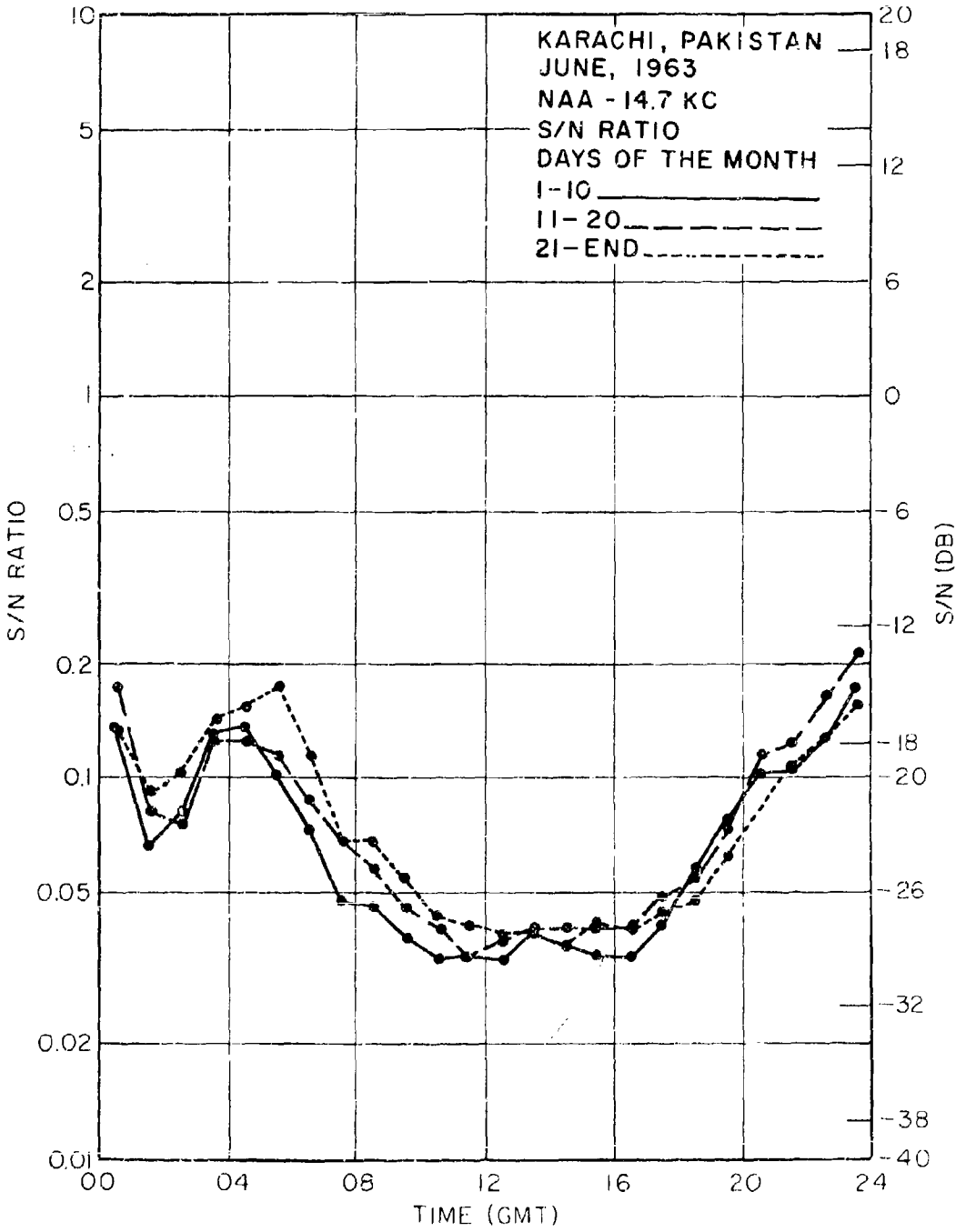

KARACHI, PAKISTAN
JUNE, 1963
NAA - 14.7 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 7

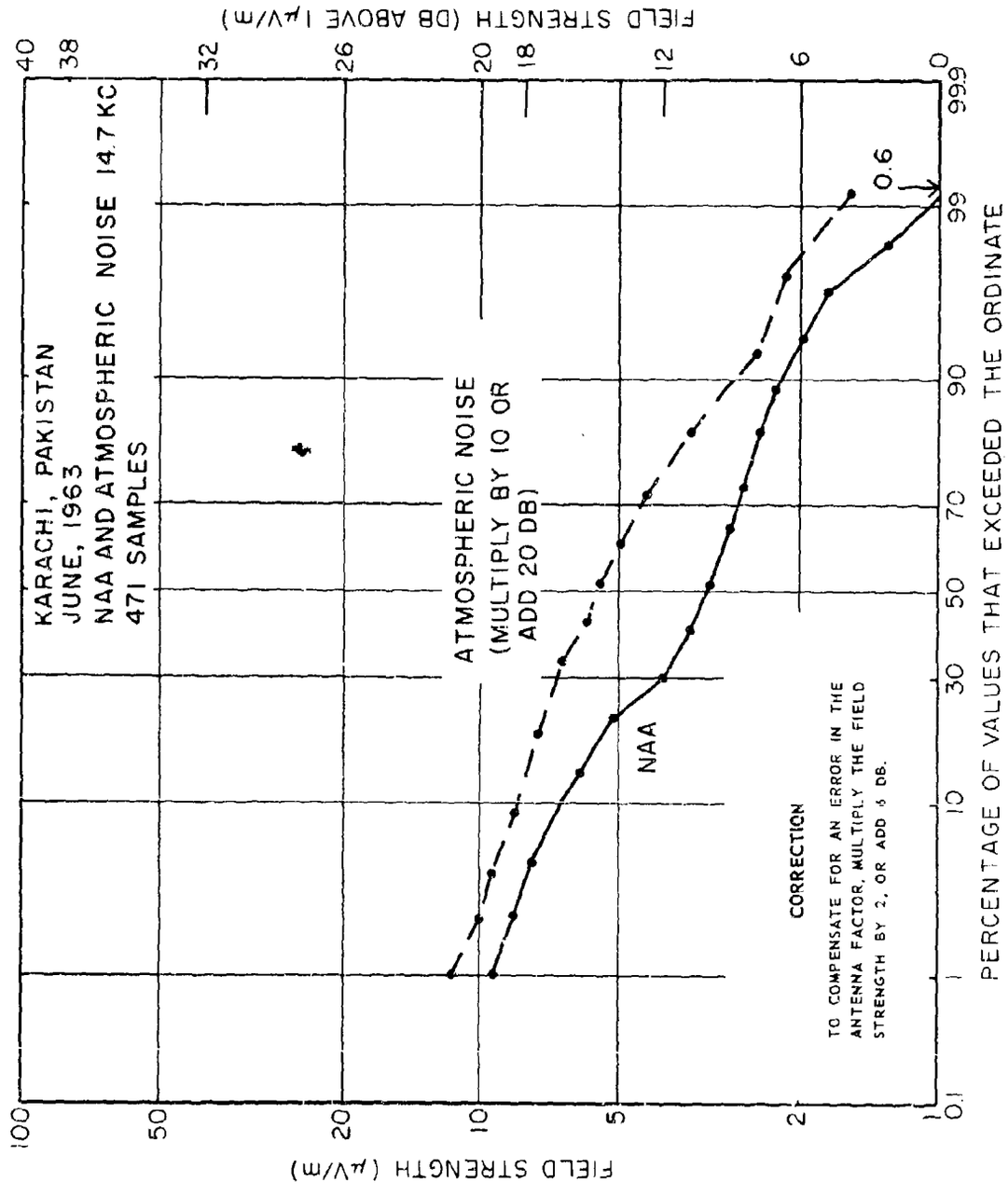

KARACHI, PAKISTAN
JUNE, 1963
NAA AND ATMOSPHERIC NOISE 14.7 KC
471 SAMPLES
ATMOSPHERIC NOISE
(MULTIPLY BY 10 OR
ADD 20 DB)
NAA
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.
0.6
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
999
99
90
70
50
30
10
1

Figure 8

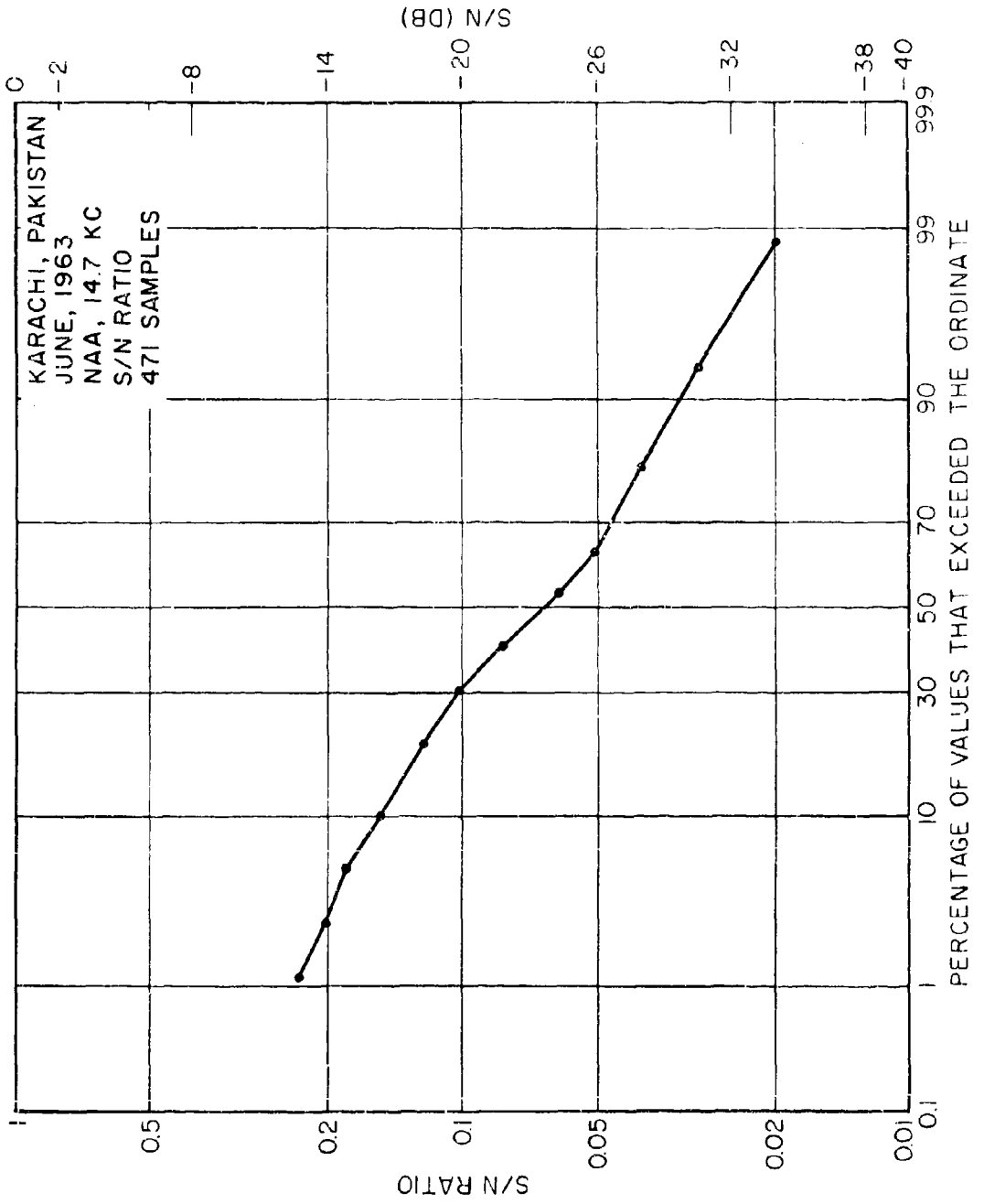

S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
KARACHI, PAKISTAN
JUNE, 1963
NAA, 14.7 KC
S/N RATIO
471 SAMPLES
999
99
90
70
50
30
10
1
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01

Figure 9

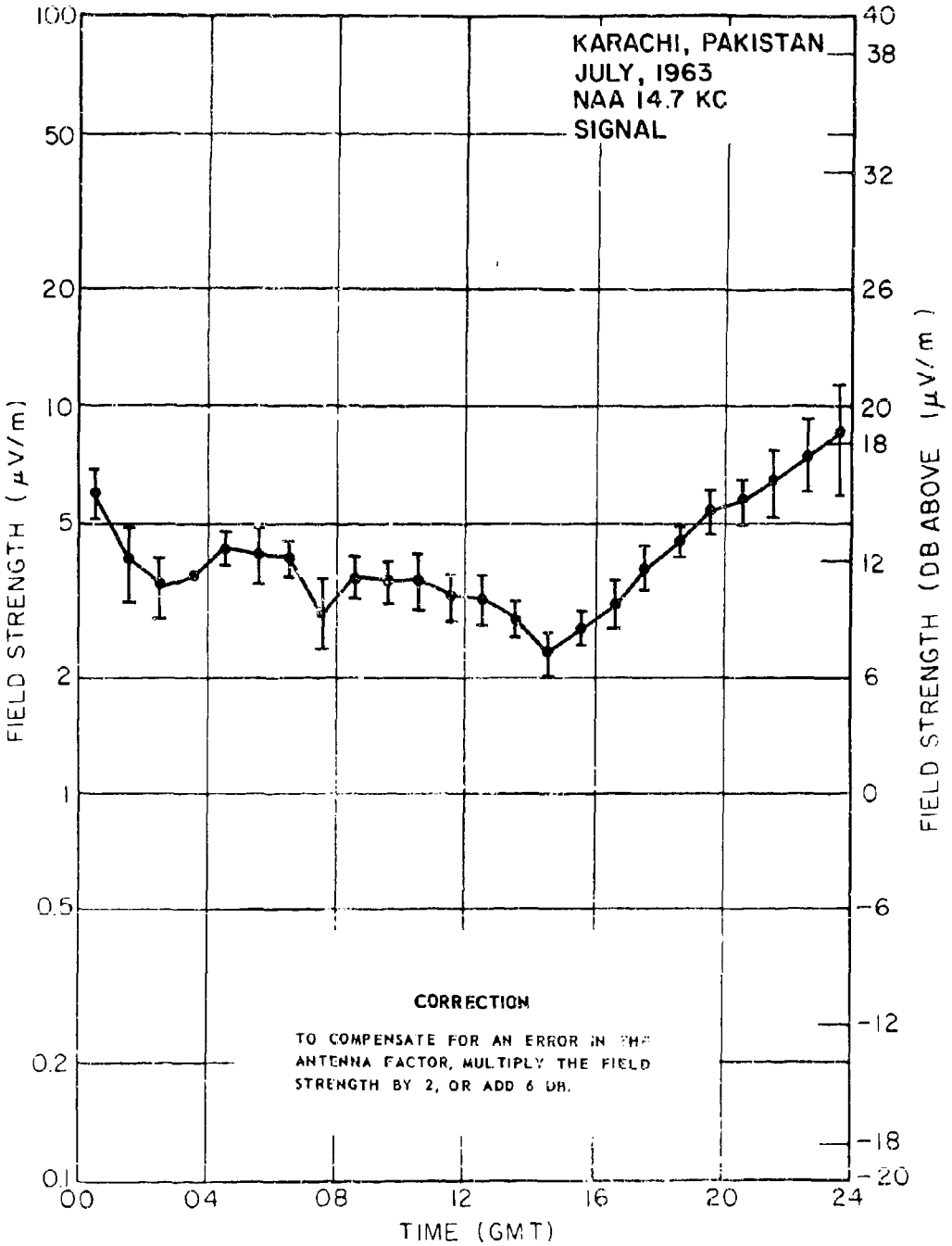
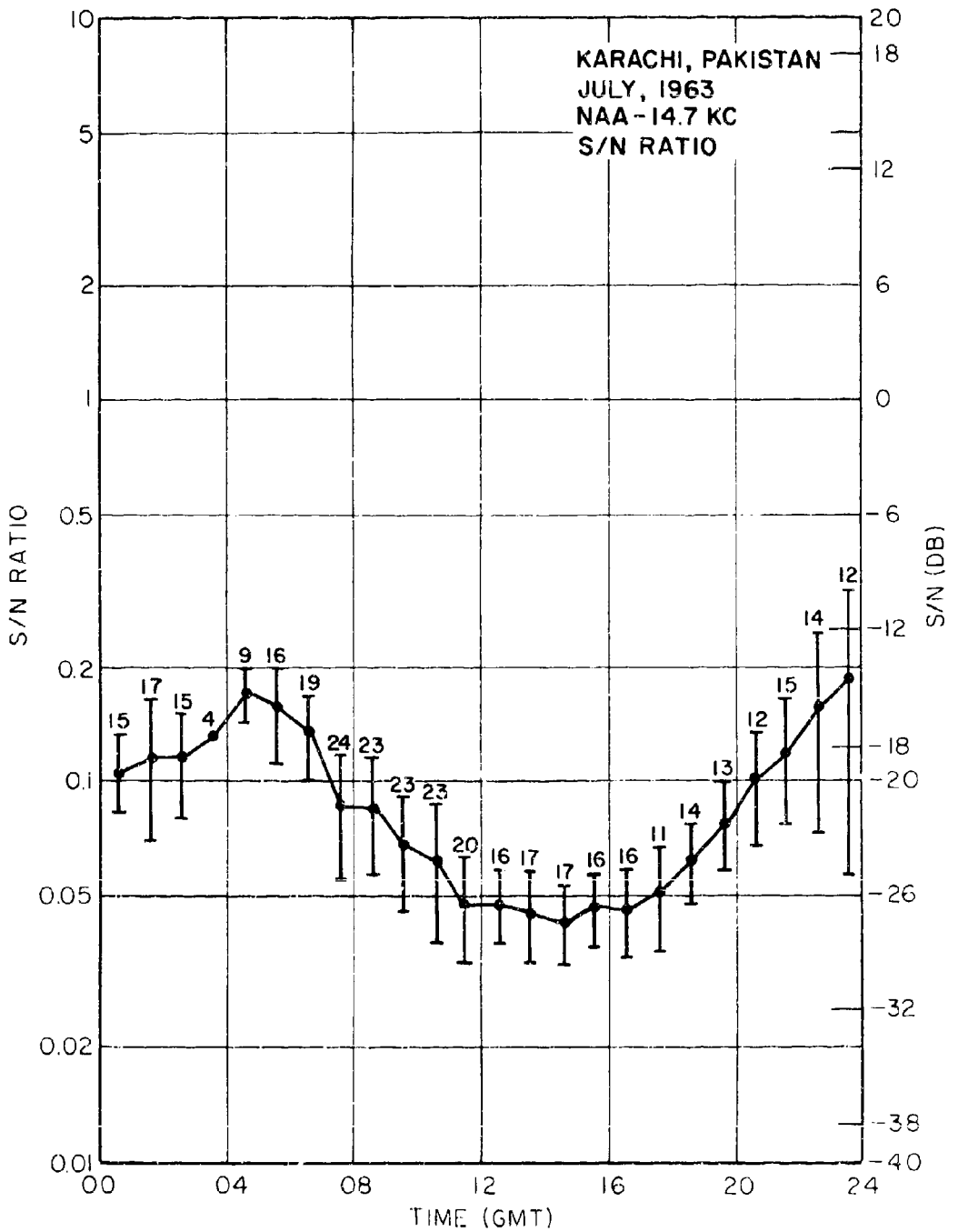

KARACHI, PAKISTAN
JULY, 1963
NAA 14.7 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 10


KARACHI, PAKISTAN
JULY, 1963
NAA - 14.7 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
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14
12

Figure 11

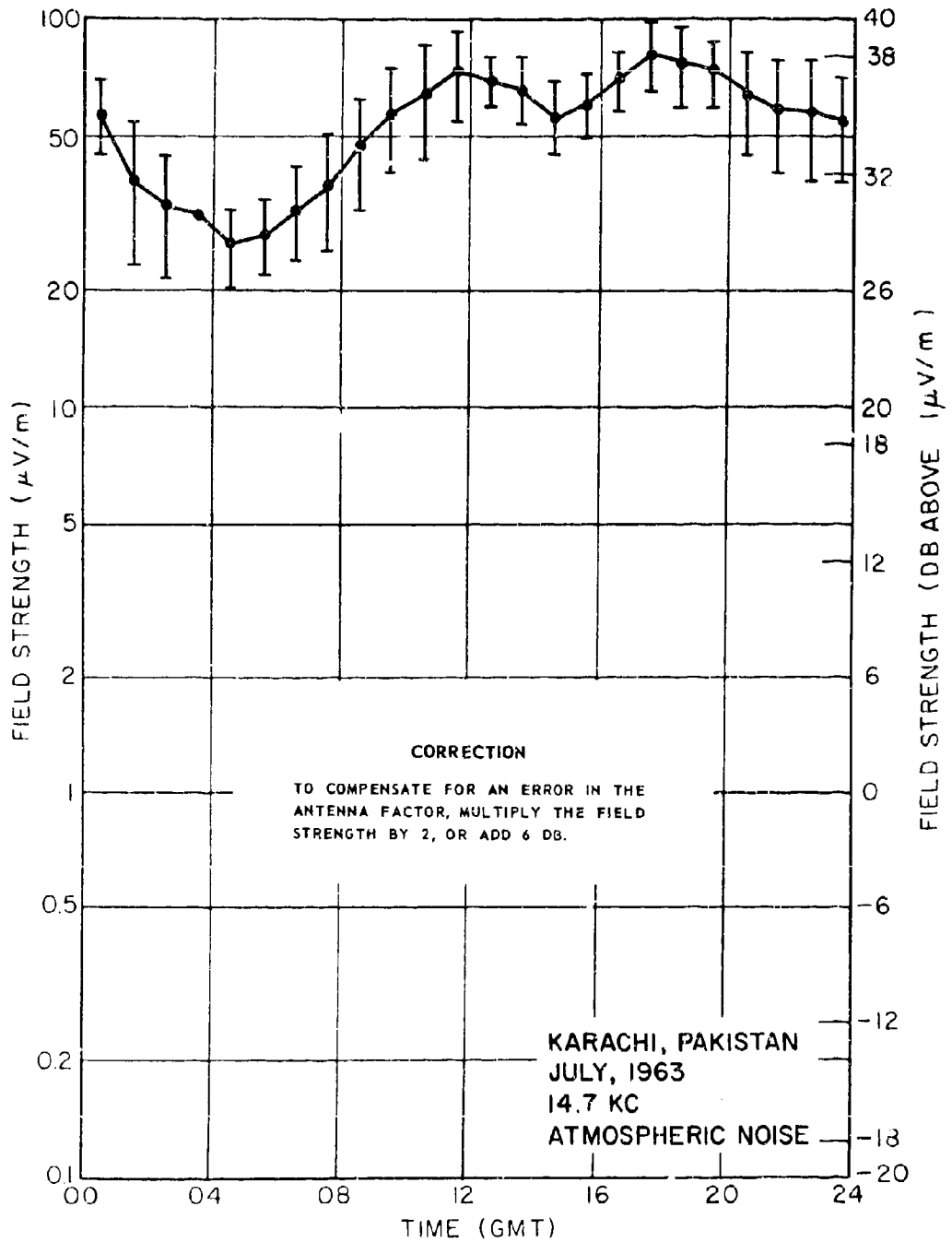
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
JULY, 1963
14.7 KC
ATMOSPHERIC NOISE

Figure 12

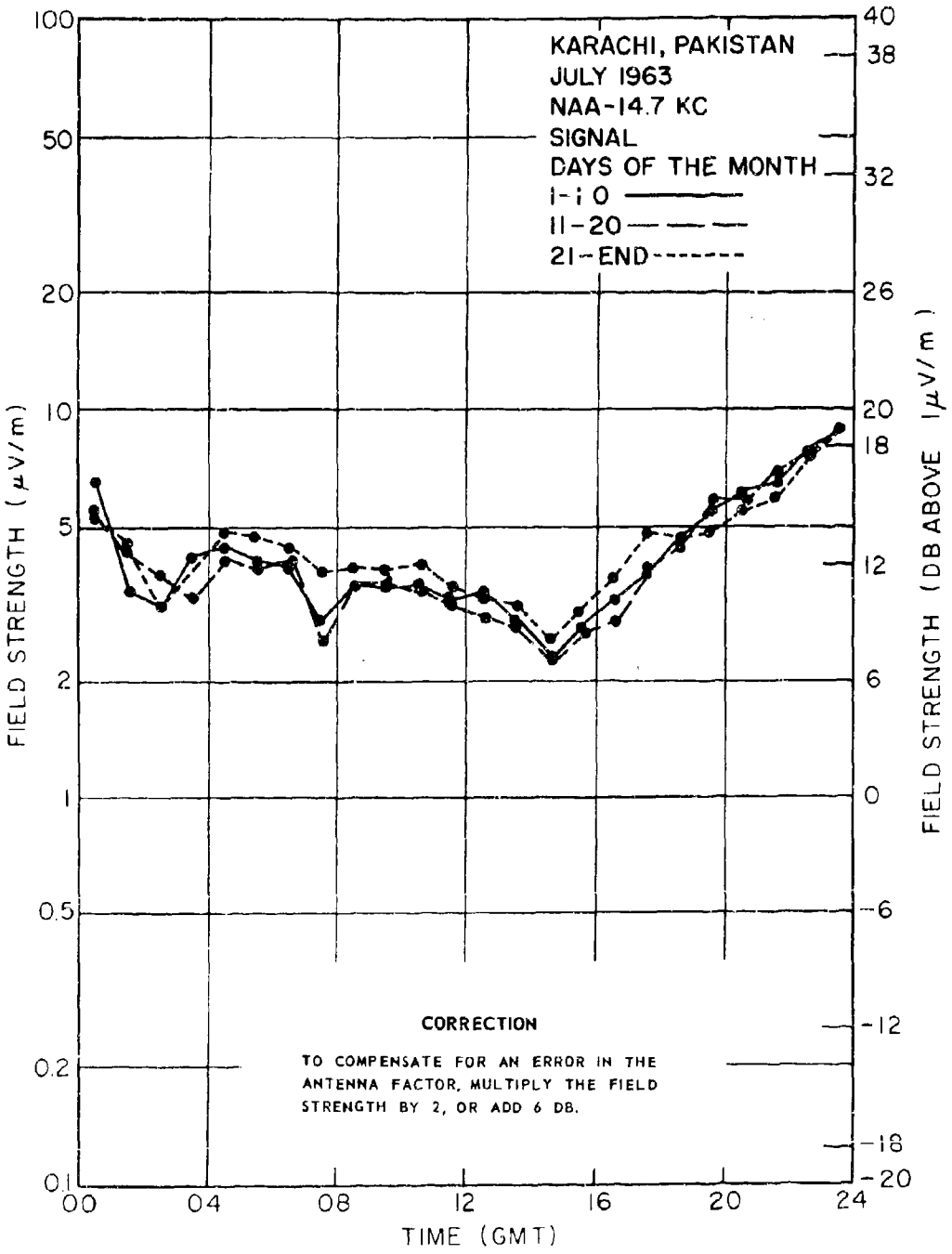
KARACHI, PAKISTAN
JULY 1963
NAA-14.7 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 13

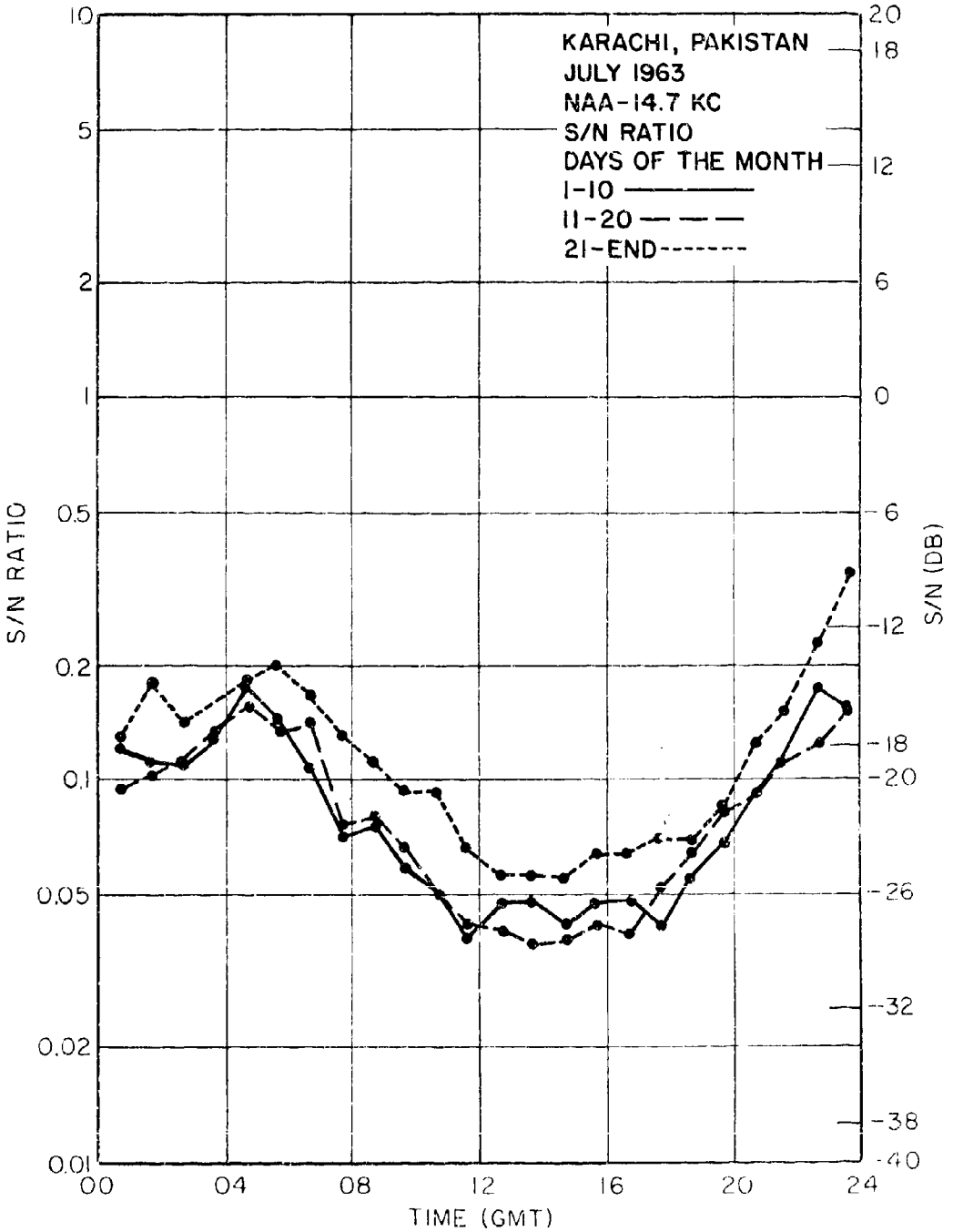
KARACHI, PAKISTAN
JULY 1963
NAA-14.7 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 14

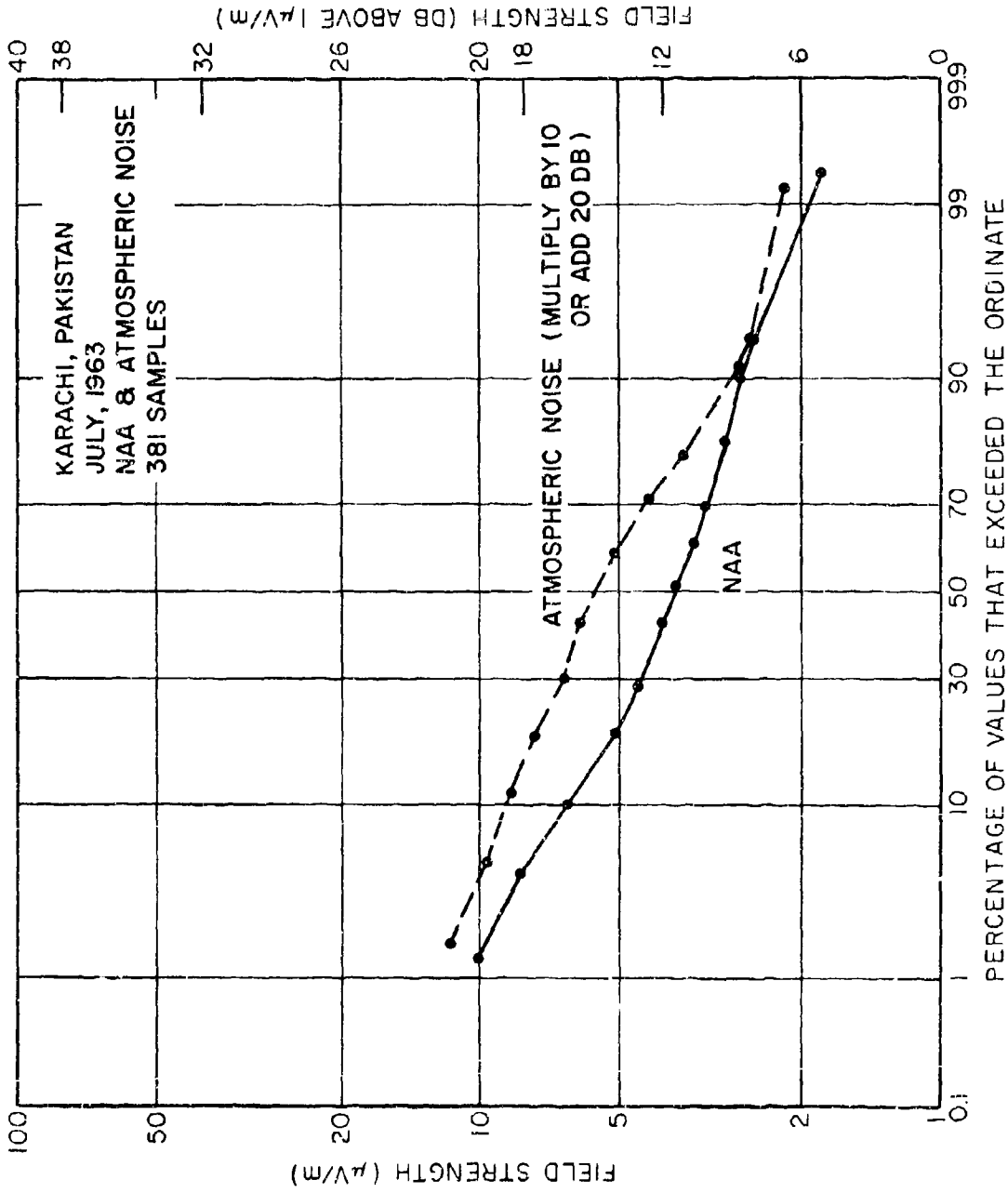
FIELD STRENGTH (DB ABOVE 1 μV/m)
40
38
32
26
20
18
12
6
0
KARACHI, PAKISTAN
JULY, 1963
NAA & ATMOSPHERIC NOISE
381 SAMPLES
ATMOSPHERIC NOISE (MULTIPLY BY 10 OR ADD 20 DB)
NAA
999
99
90
70
50
30
10
1
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
FIELD STRENGTH (μV/m)

Figure 15

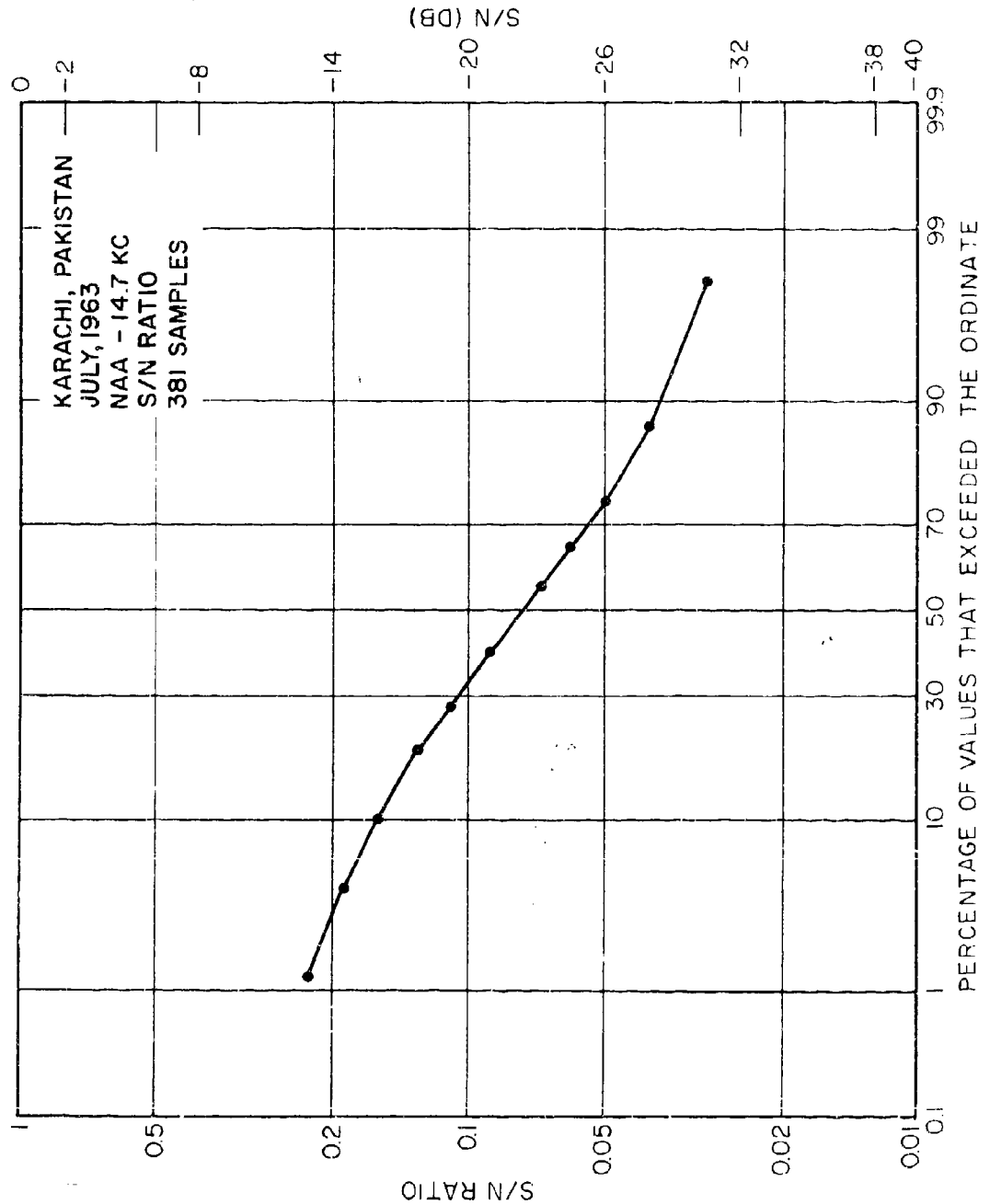
KARACHI, PAKISTAN
JULY, 1963
NAA - 14.7 KC
S/N RATIO
381 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
0.1
1
10
30
50
70
90
99
99.9
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE

Figure 16

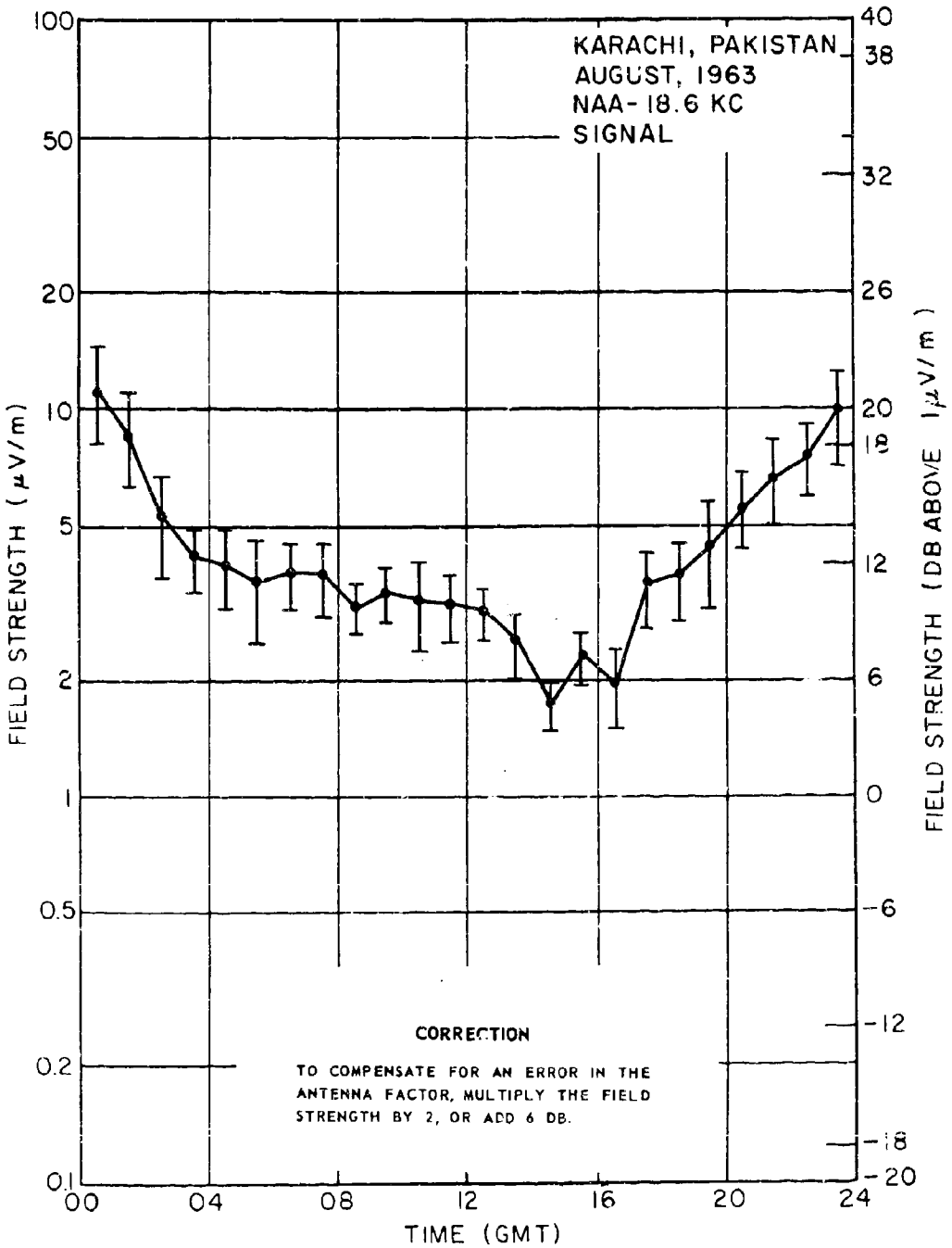
KARACHI, PAKISTAN
AUGUST, 1963
NAA- 18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 17

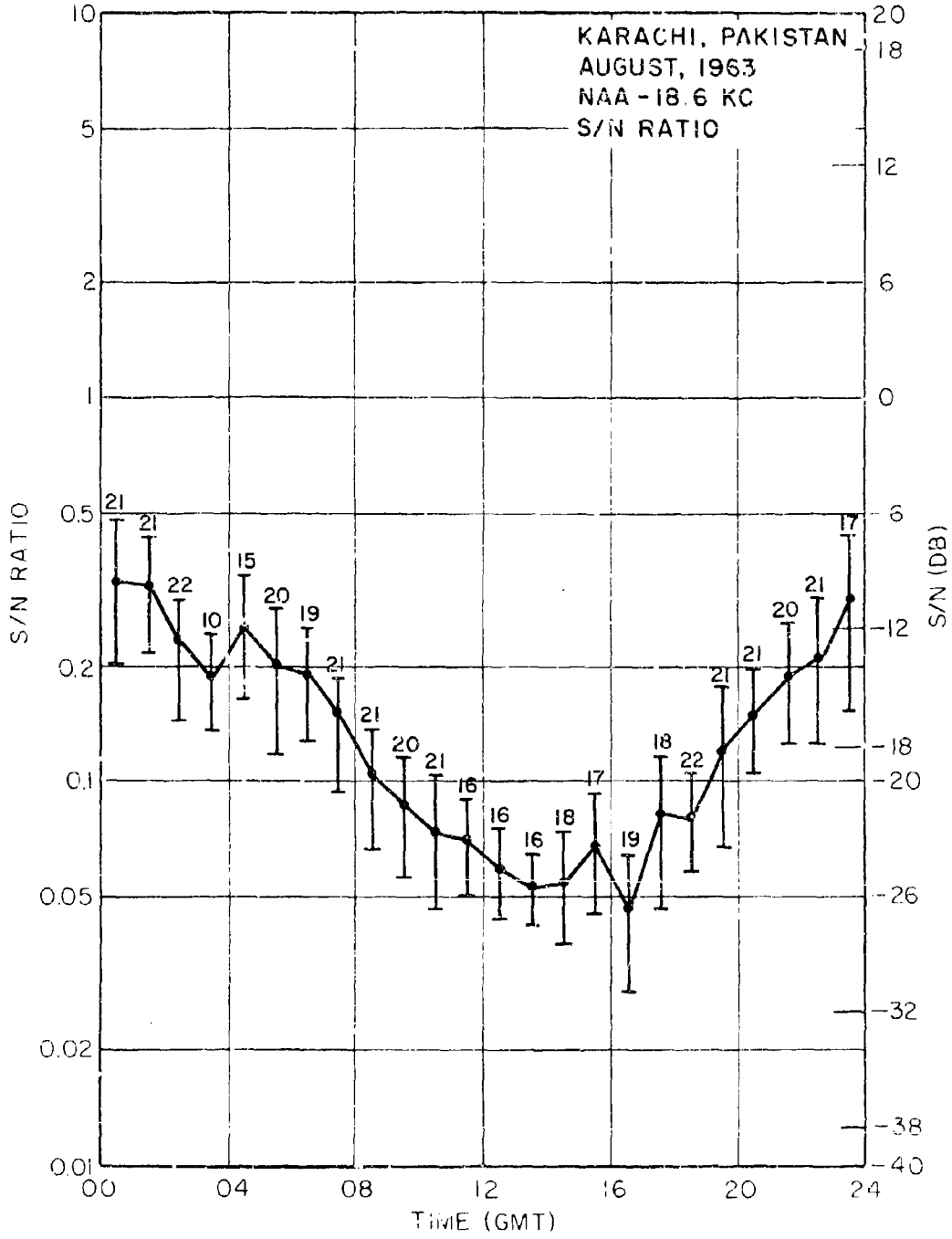
KARACHI, PAKISTAN
AUGUST, 1963
NAA - 18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
21
21
22
10
15
20
19
21
21
20
21
16
16
16
18
17
19
18
22
21
21
20
21
17

Figure 18

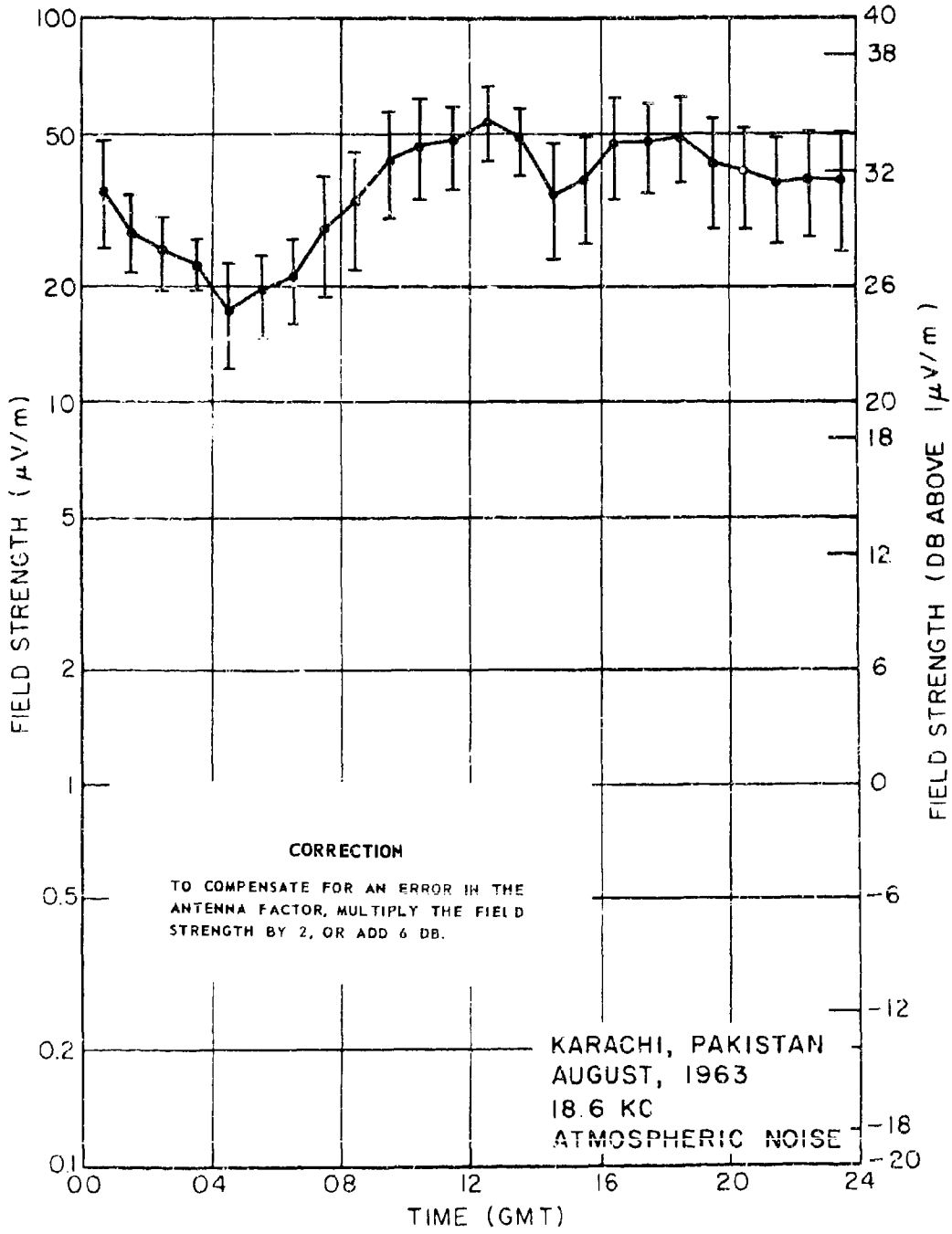
100
50
20
10
5
2
1
0.5
0.2
0.1
FIELD STRENGTH (μV/m)
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
FIELD STRENGTH (DB ABOVE 1μV/m)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
AUGUST, 1963
18.6 KC
ATMOSPHERIC NOISE
00
04
08
12
16
20
24
TIME (GMT)

Figure 19

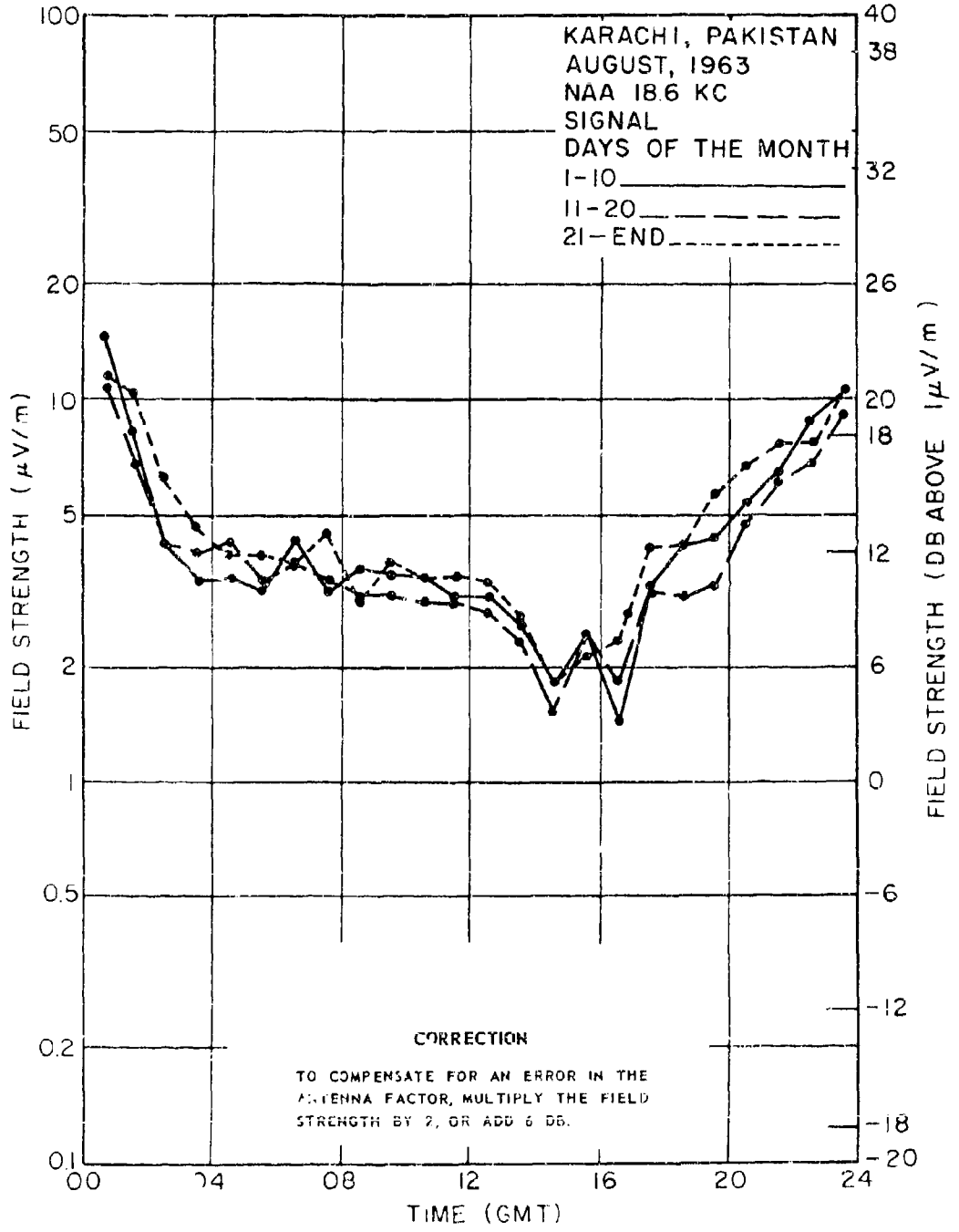
KARACHI, PAKISTAN
AUGUST, 1963
NAA 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 20

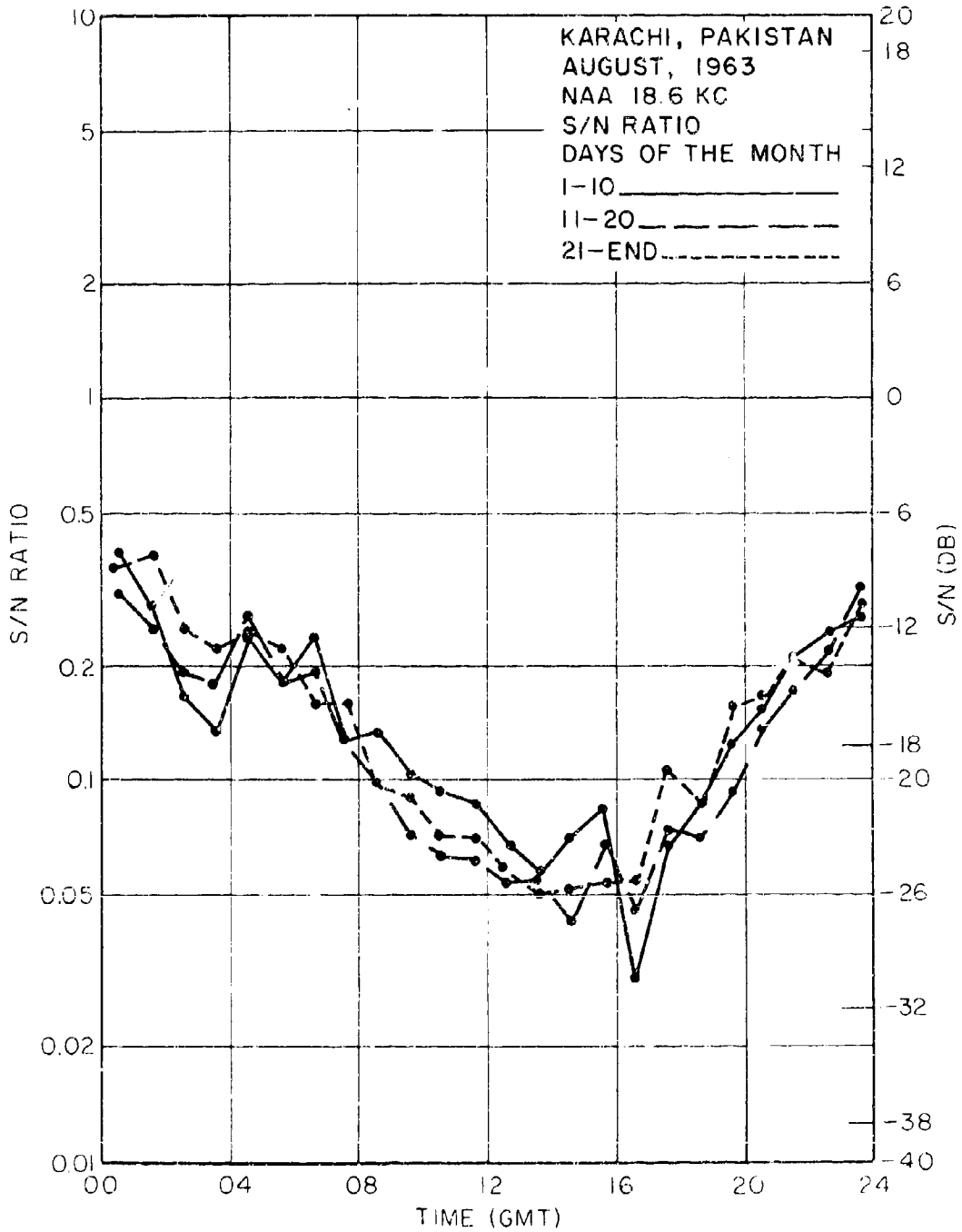
KARACHI, PAKISTAN
AUGUST, 1963
NAA 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 21

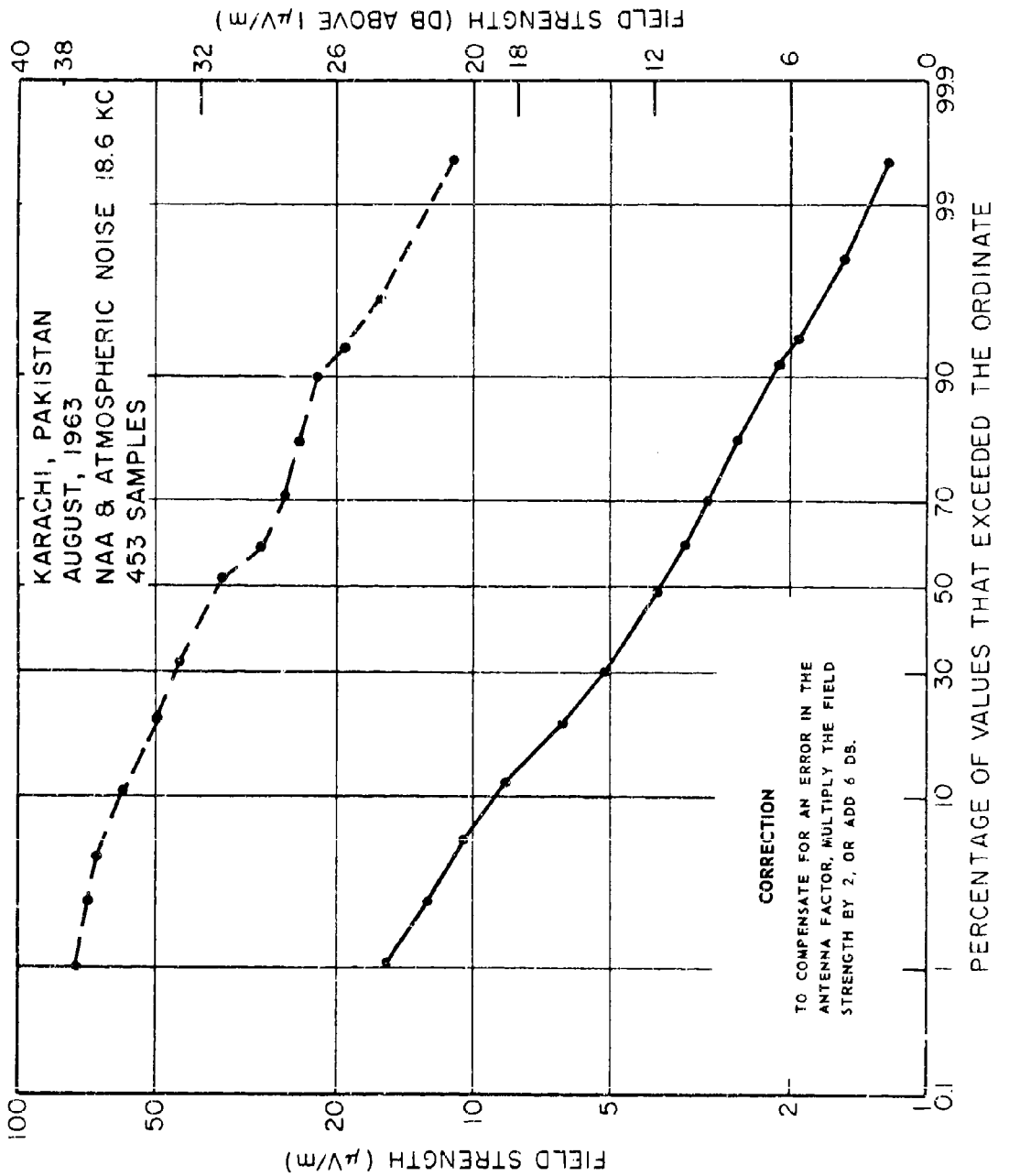
KARACHI, PAKISTAN
AUGUST, 1963
NAA & ATMOSPHERIC NOISE 18.6 KC
453 SAMPLES
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (DB ABOVE 1μV/m)
FIELD STRENGTH (μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE

Figure 22

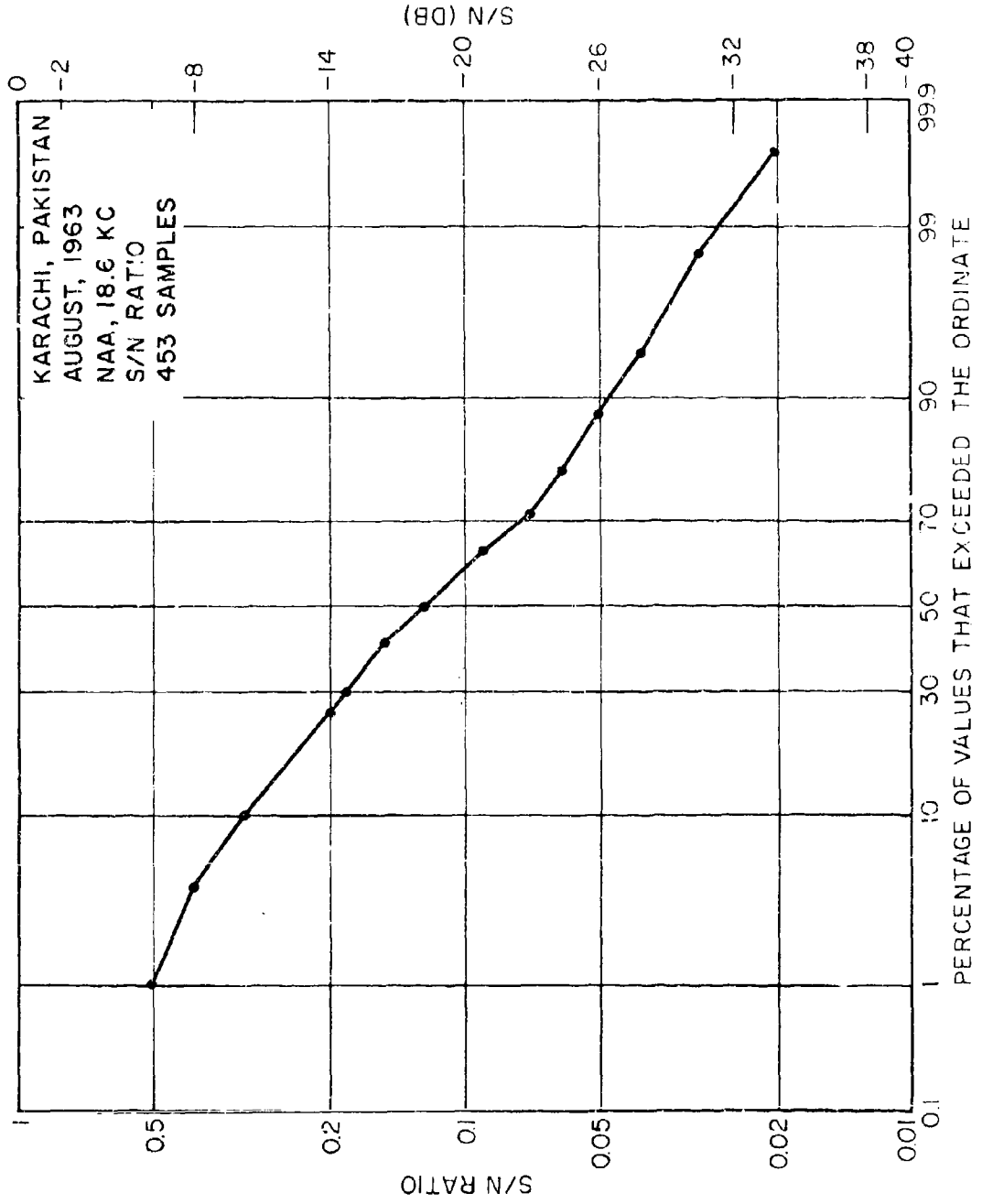
KARACHI, PAKISTAN
AUGUST, 1963
NAA, 18.6 KC
S/N RATIO
453 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 23

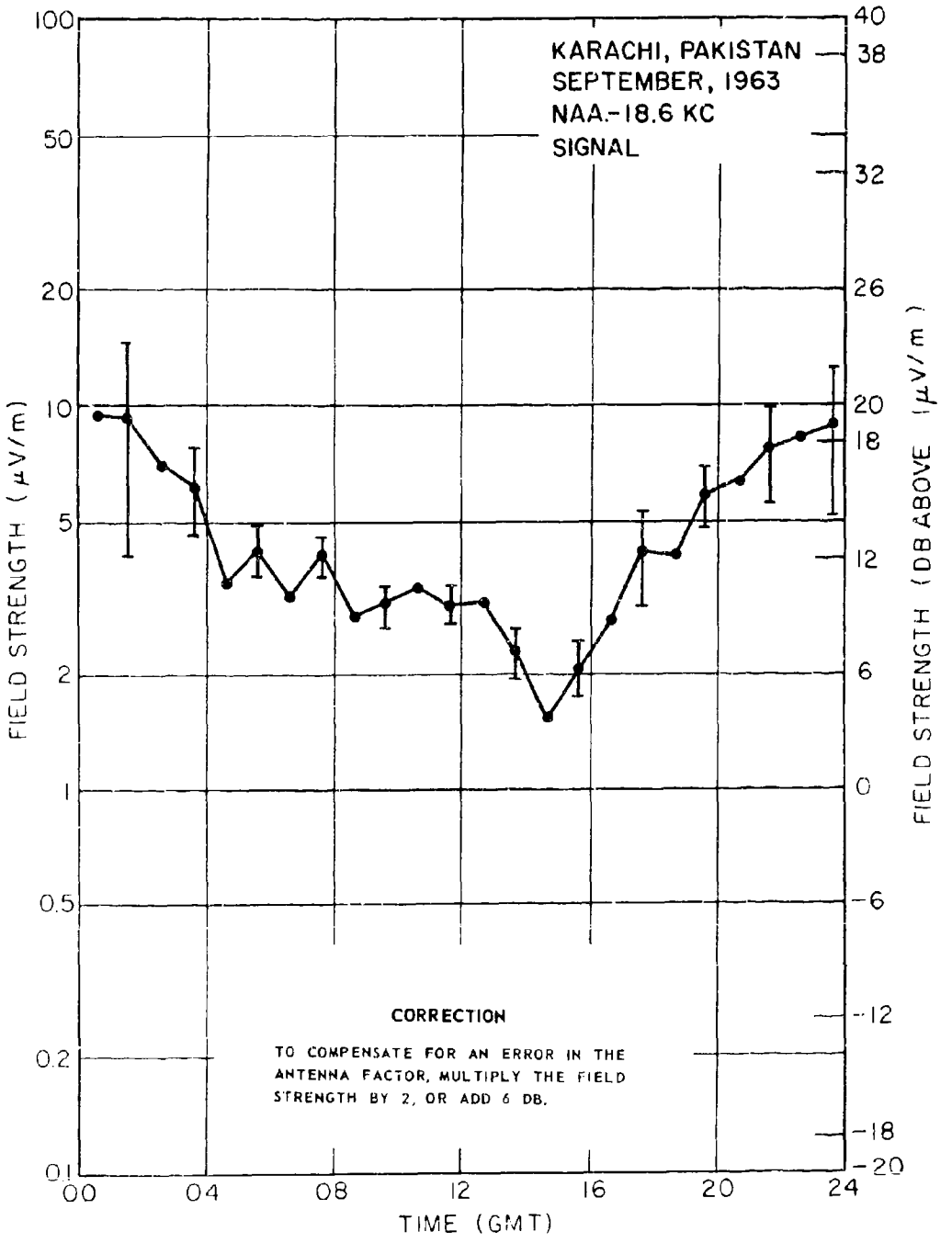
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA.-18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 24

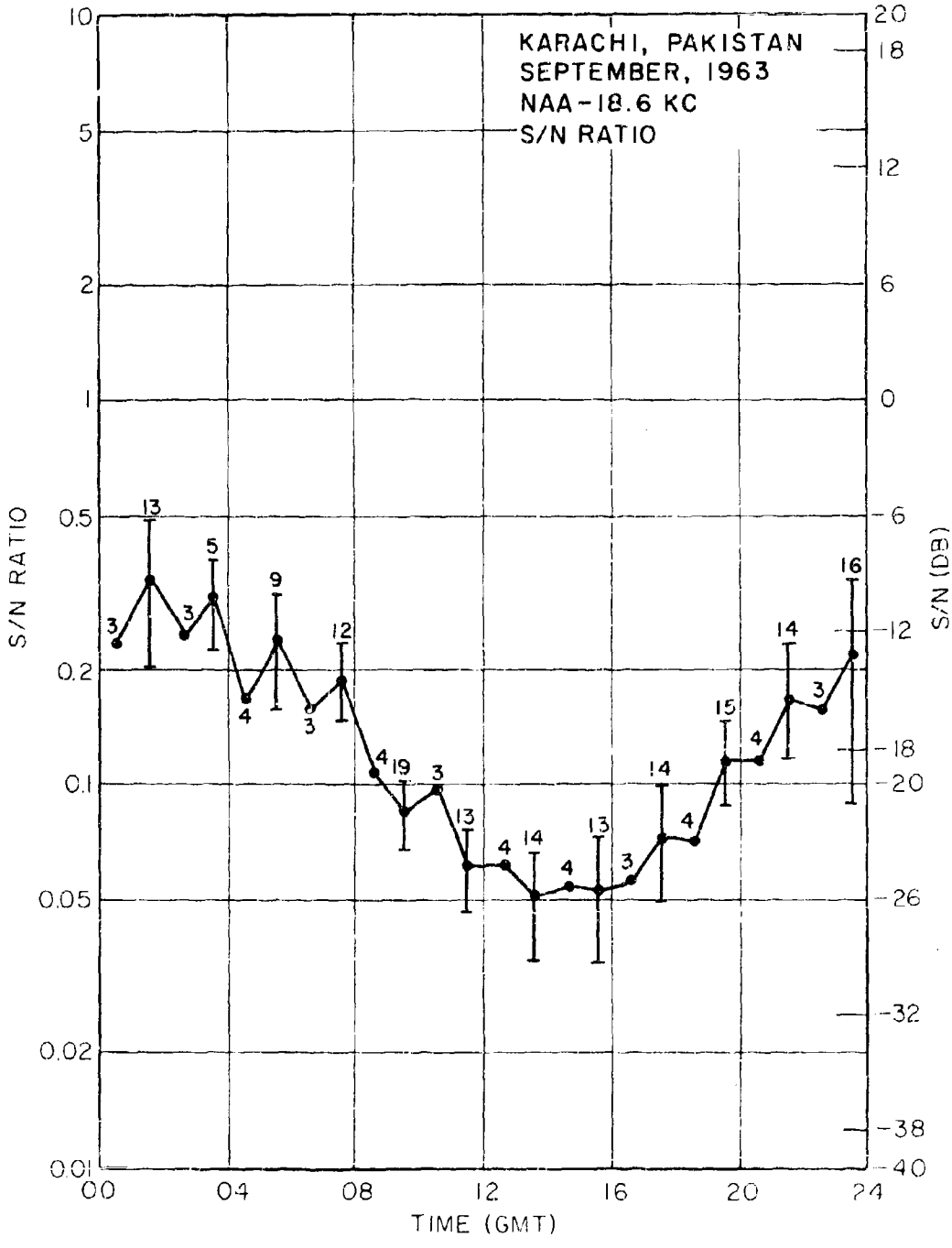
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA-18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
3
13
3
5
4
9
3
12
4
19
3
13
4
14
4
13
3
14
4
15
4
14
3
16

Figure 25

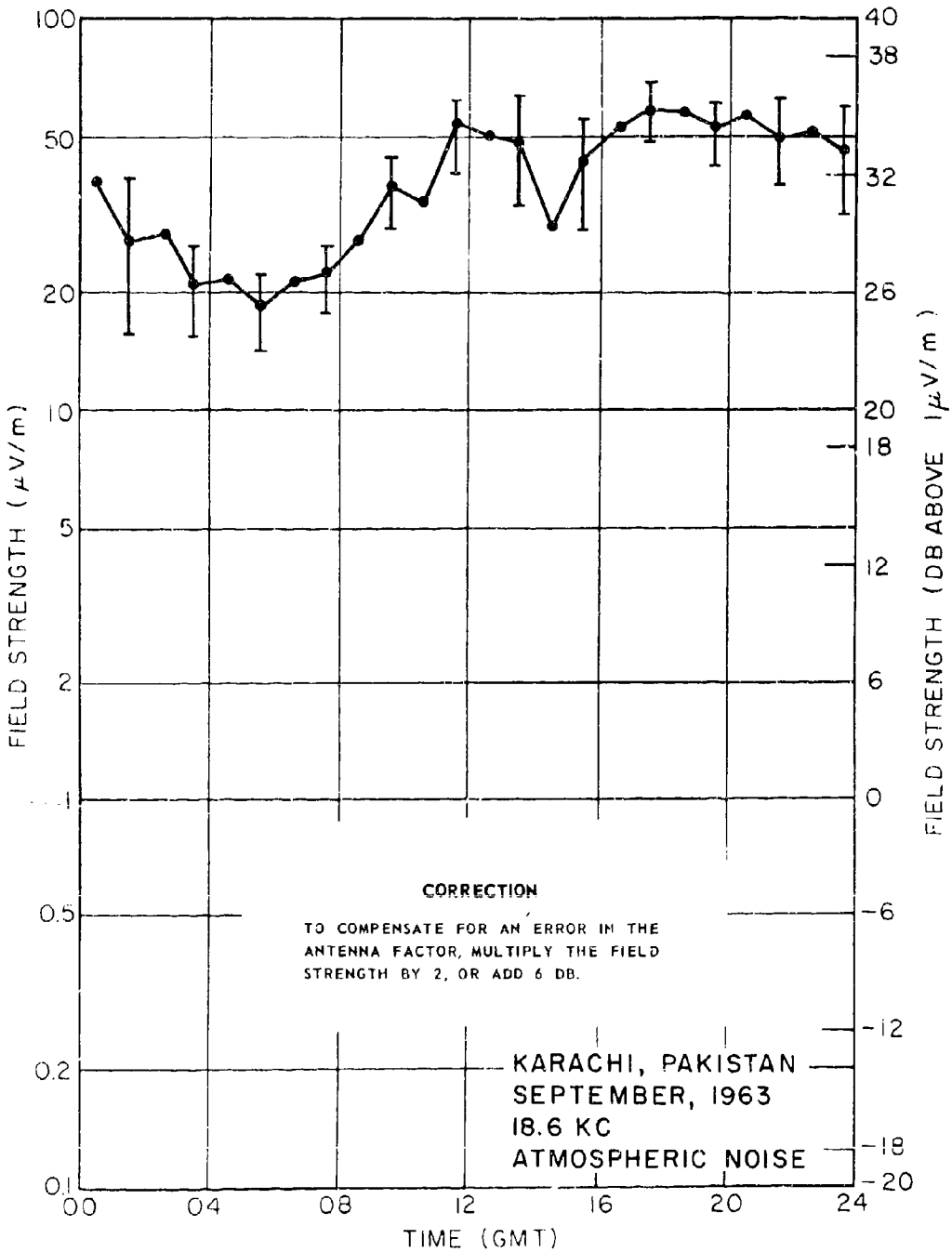
100
50
20
10
5
2
1
0.5
0.2
0.1
FIELD STRENGTH (μV/m)
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
FIELD STRENGTH (DB ABOVE 1μV/m)
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
SEPTEMBER, 1963
18.6 KC
ATMOSPHERIC NOISE

Figure 26

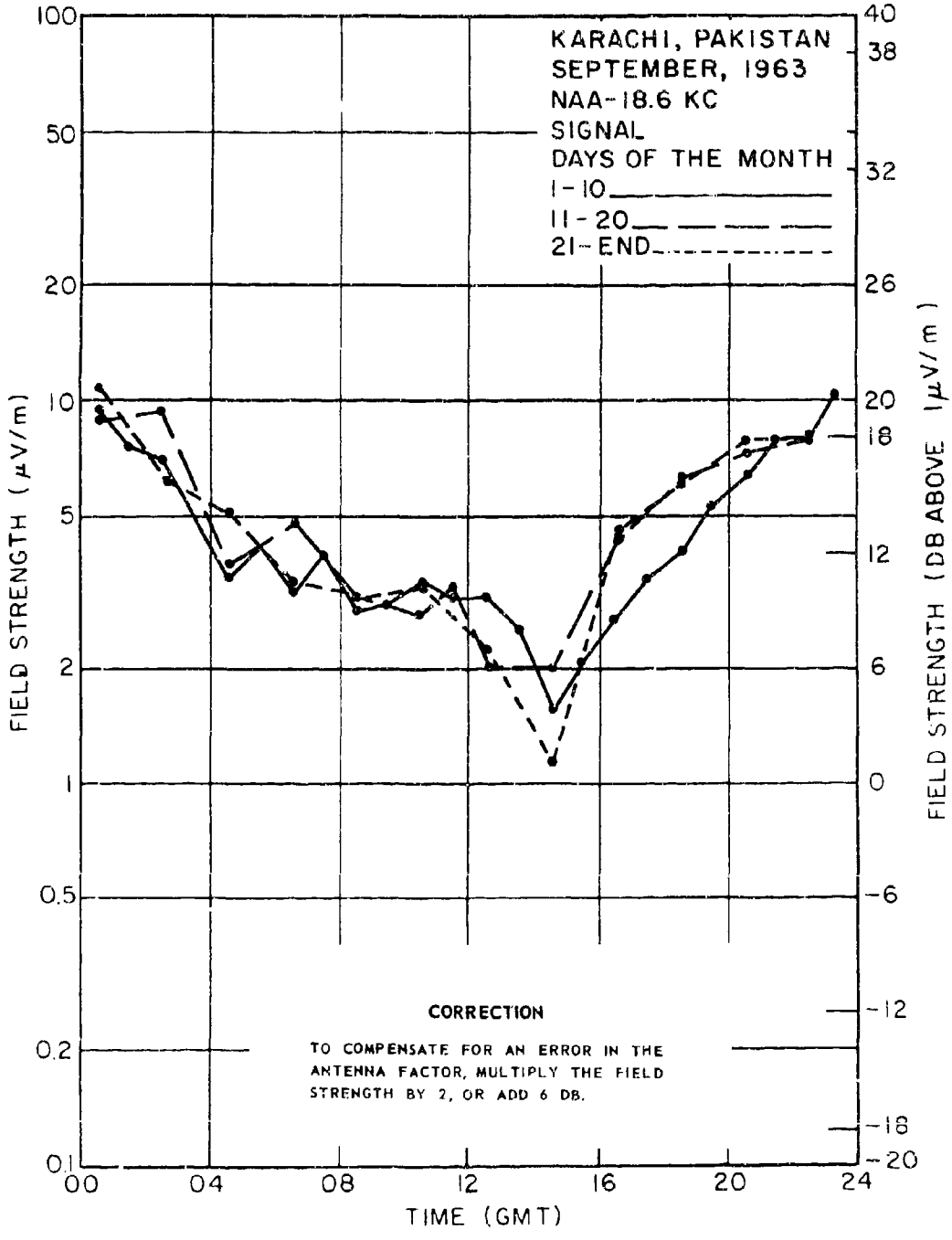
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA-18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 27

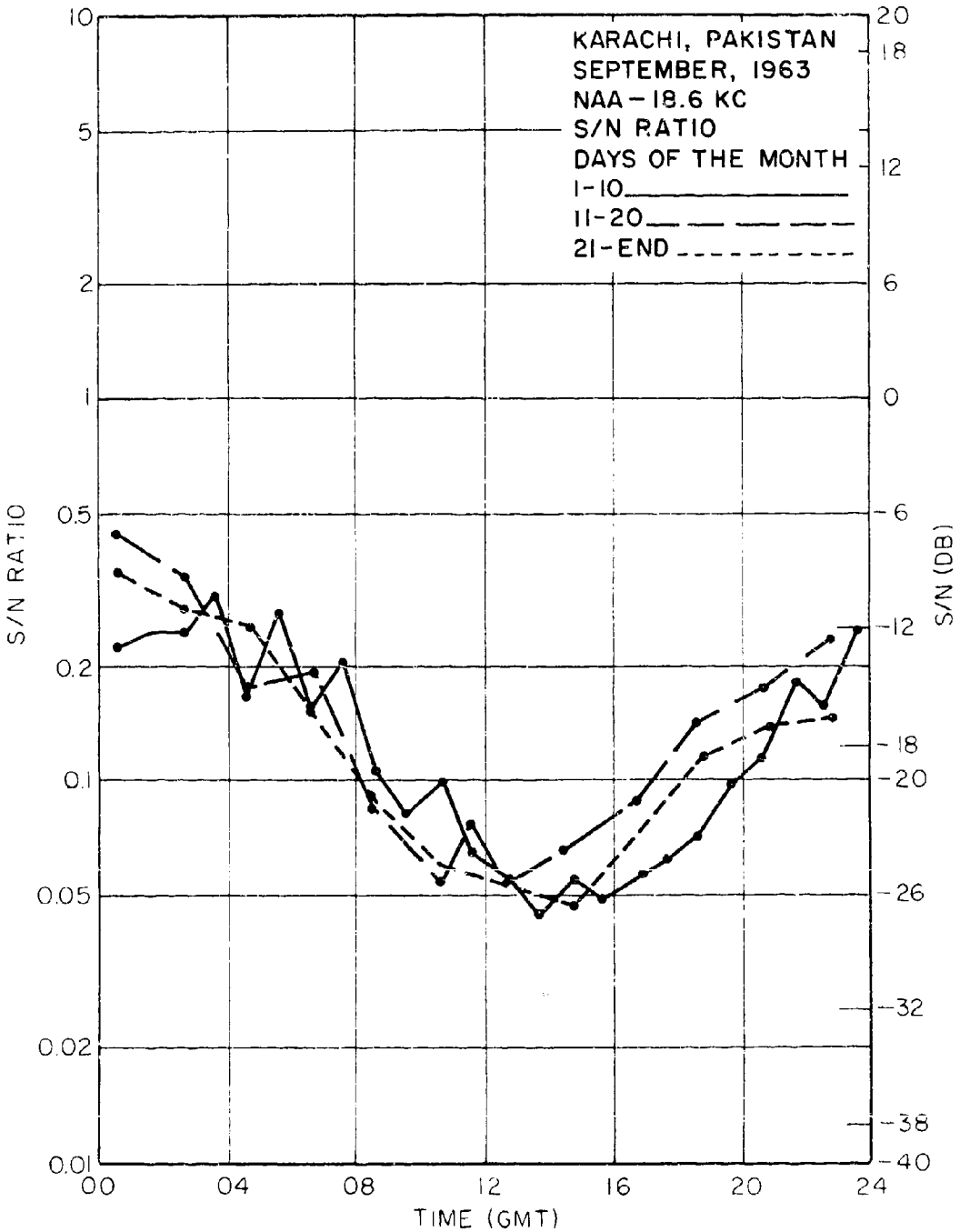
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA – 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 28

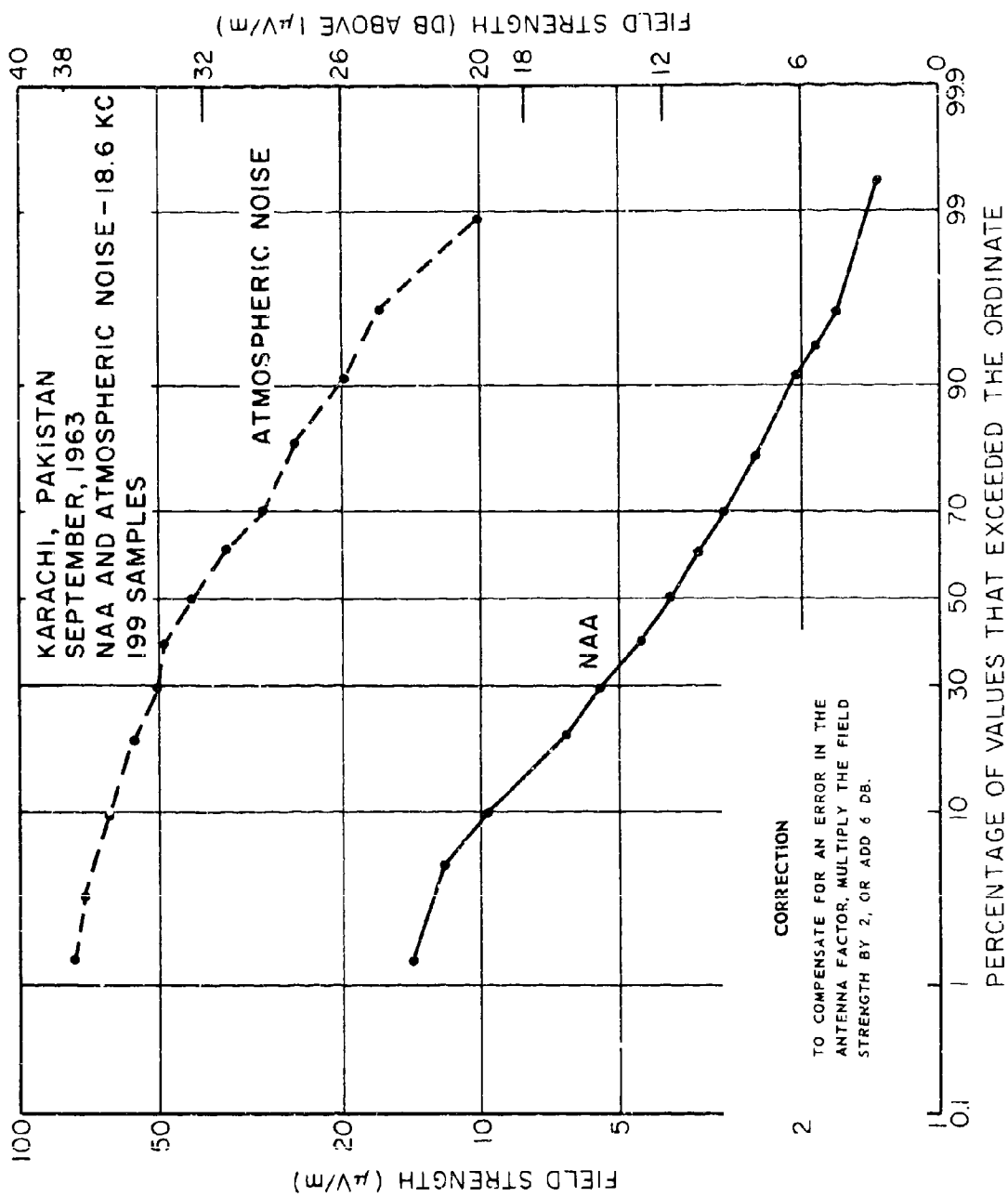
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA AND ATMOSPHERIC NOISE - 18.6 KC
199 SAMPLES
ATMOSPHERIC NOISE
NAA
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1 μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
99.9
99
90
70
50
30
10
1

Figure 29

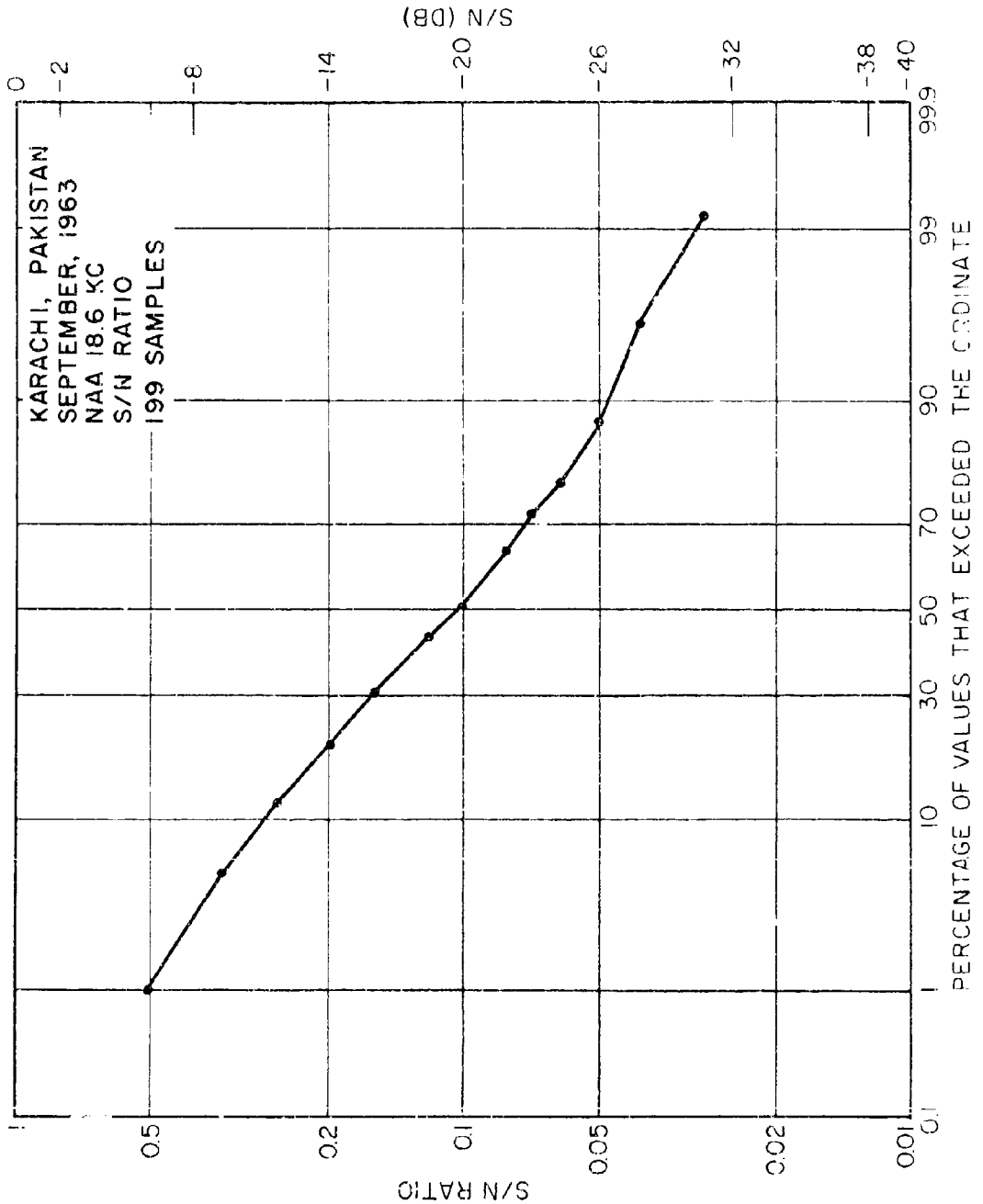
KARACHI, PAKISTAN
SEPTEMBER, 1963
NAA 18.6 KC
S/N RATIO
199 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 30

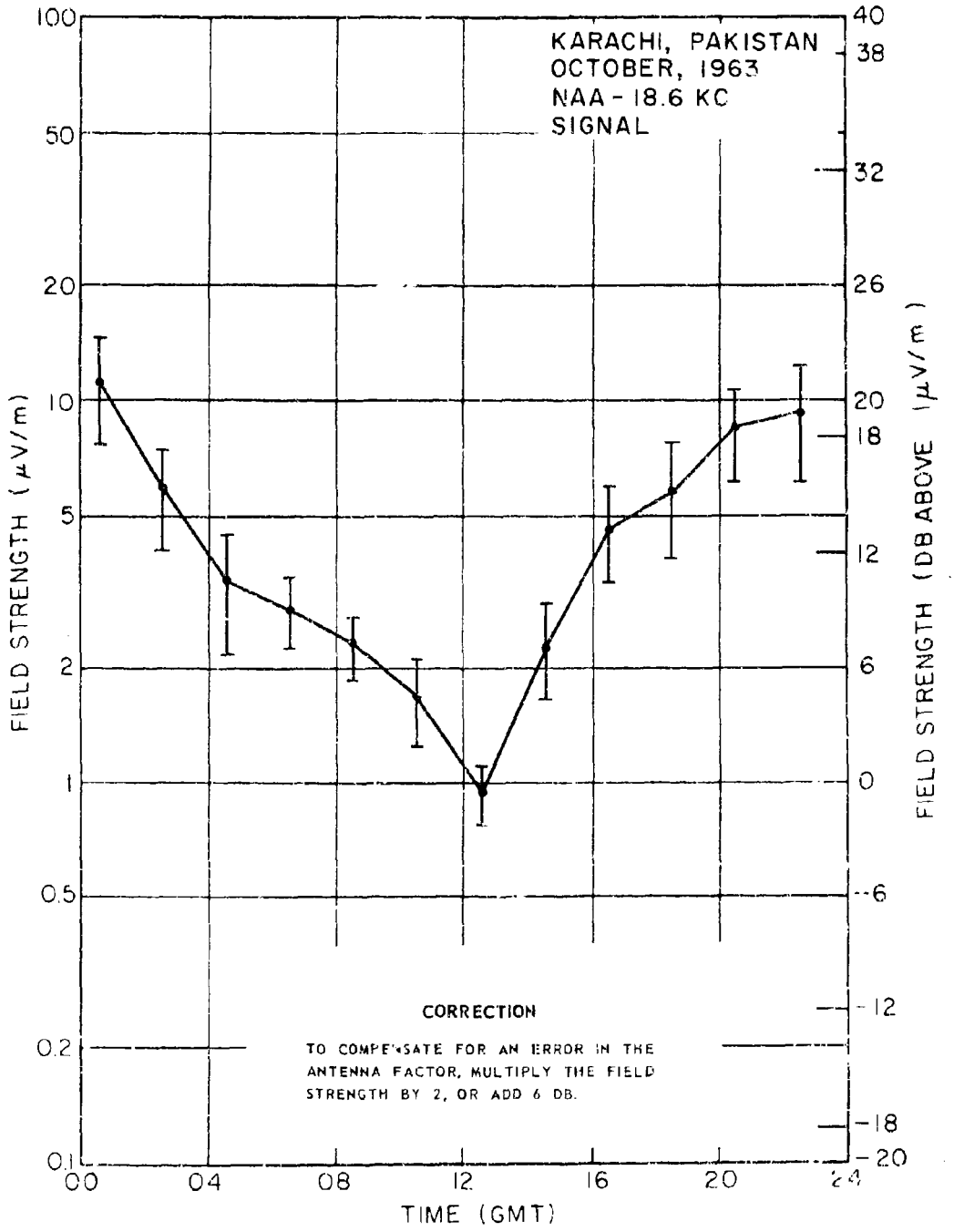
KARACHI, PAKISTAN
OCTOBER, 1963
NAA - 18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 31

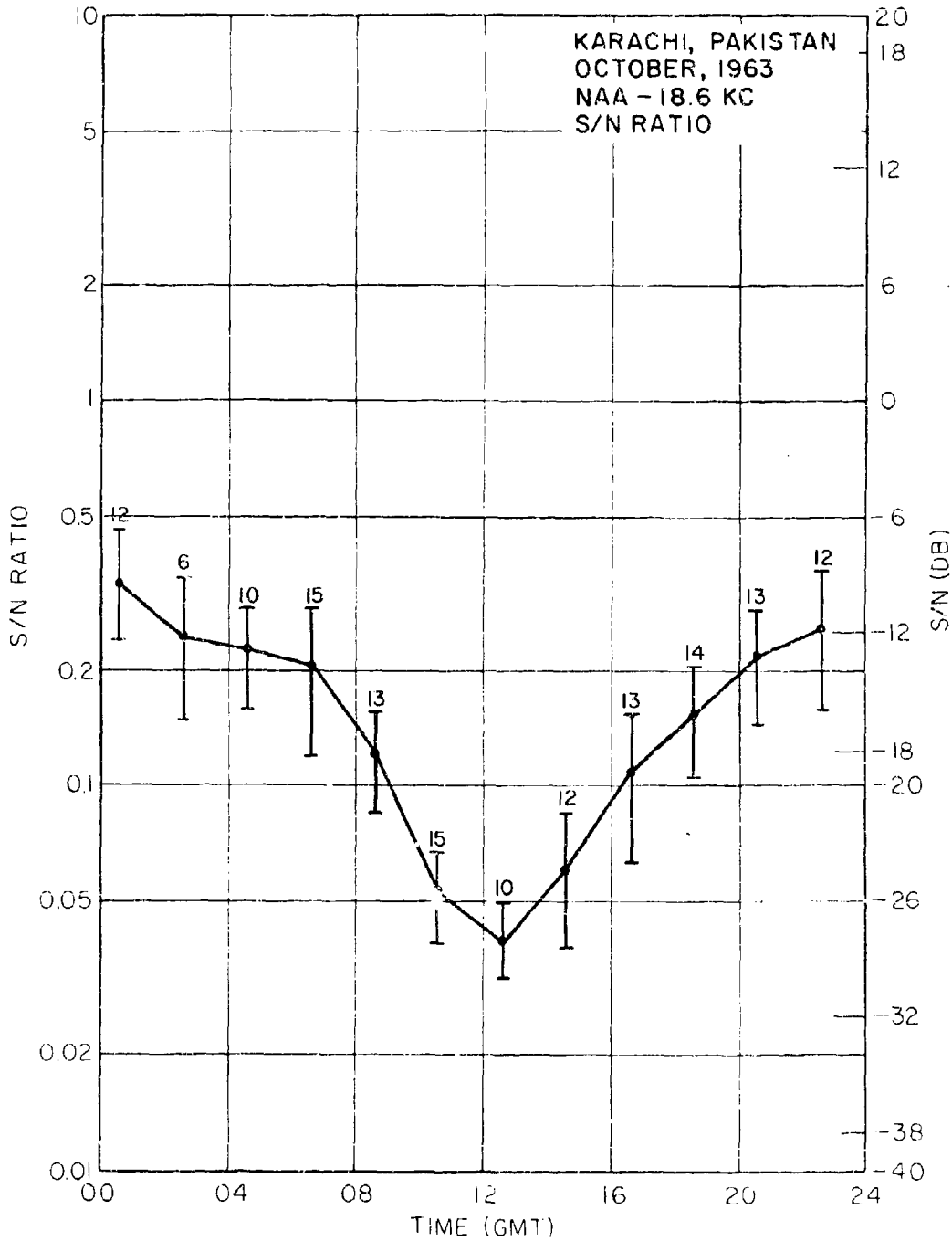
KARACHI, PAKISTAN
OCTOBER, 1963
NAA – 18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
12
6
10
15
13
15
10
12
13
14
13
12

Figure 32

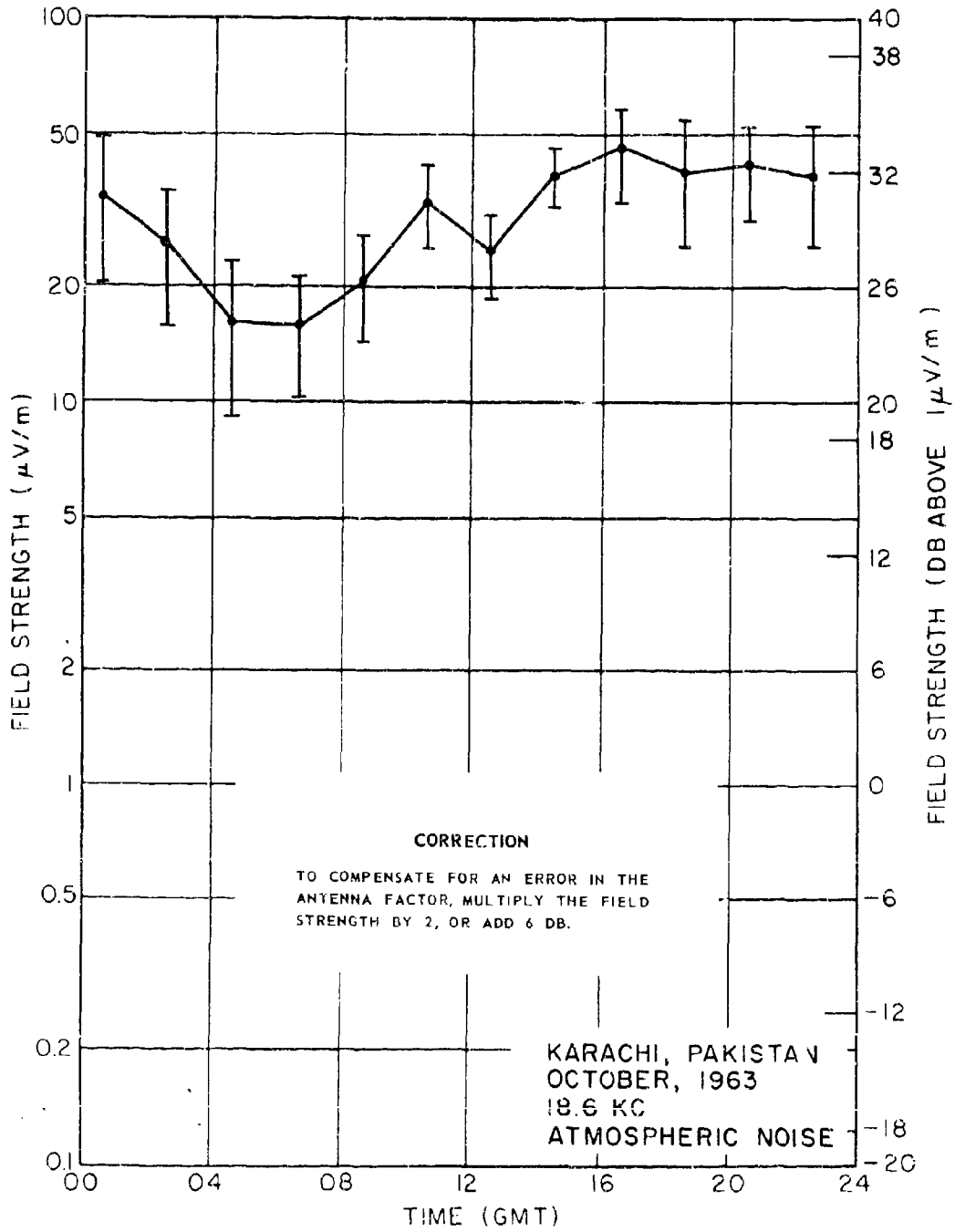
FIELD STRENGTH (μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
FIELD STRENGTH (DB ABOVE 1μV/m)
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
OCTOBER, 1963
18.6 KC
ATMOSPHERIC NOISE

Figure 33

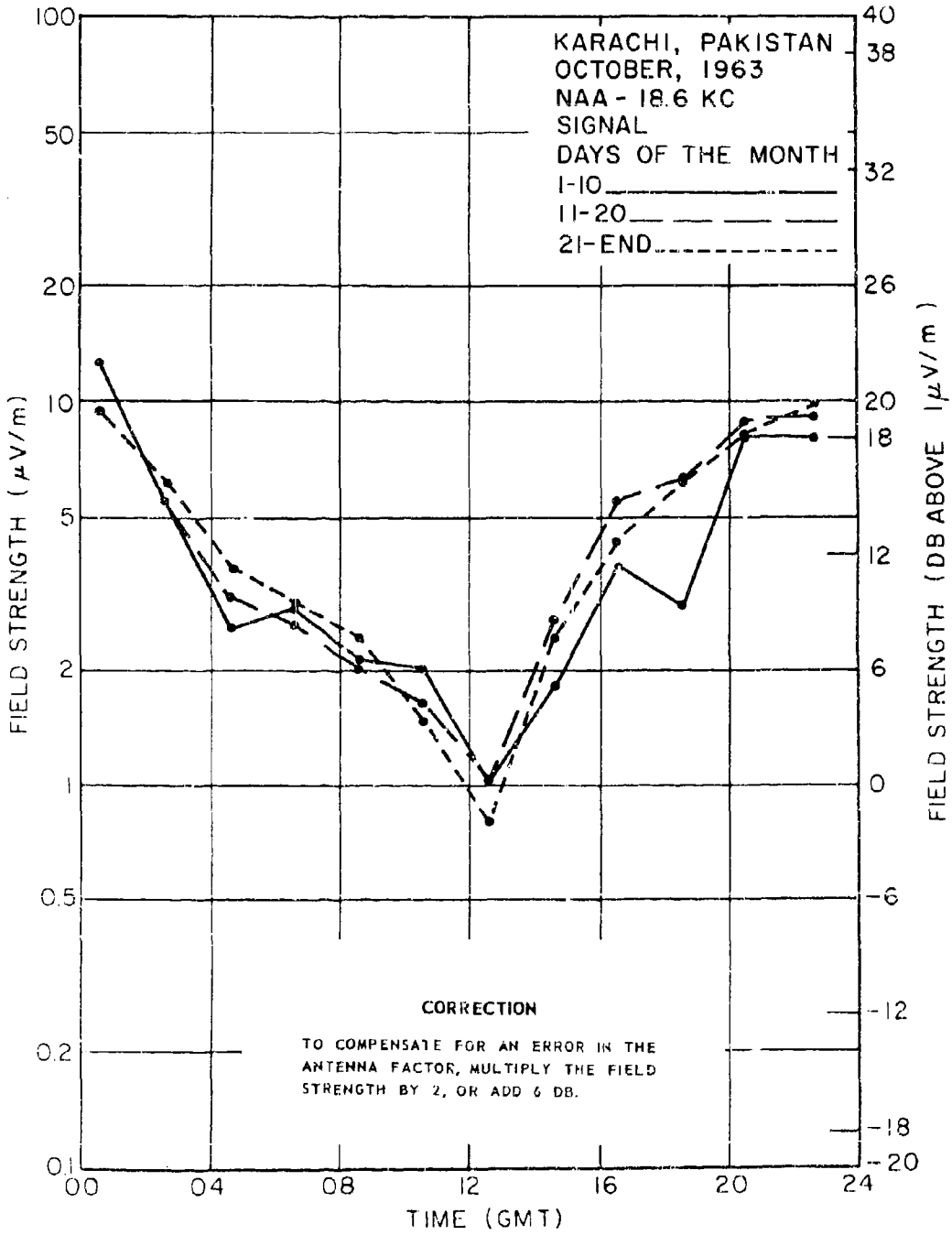
KARACHI, PAKISTAN
OCTOBER, 1963
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 34

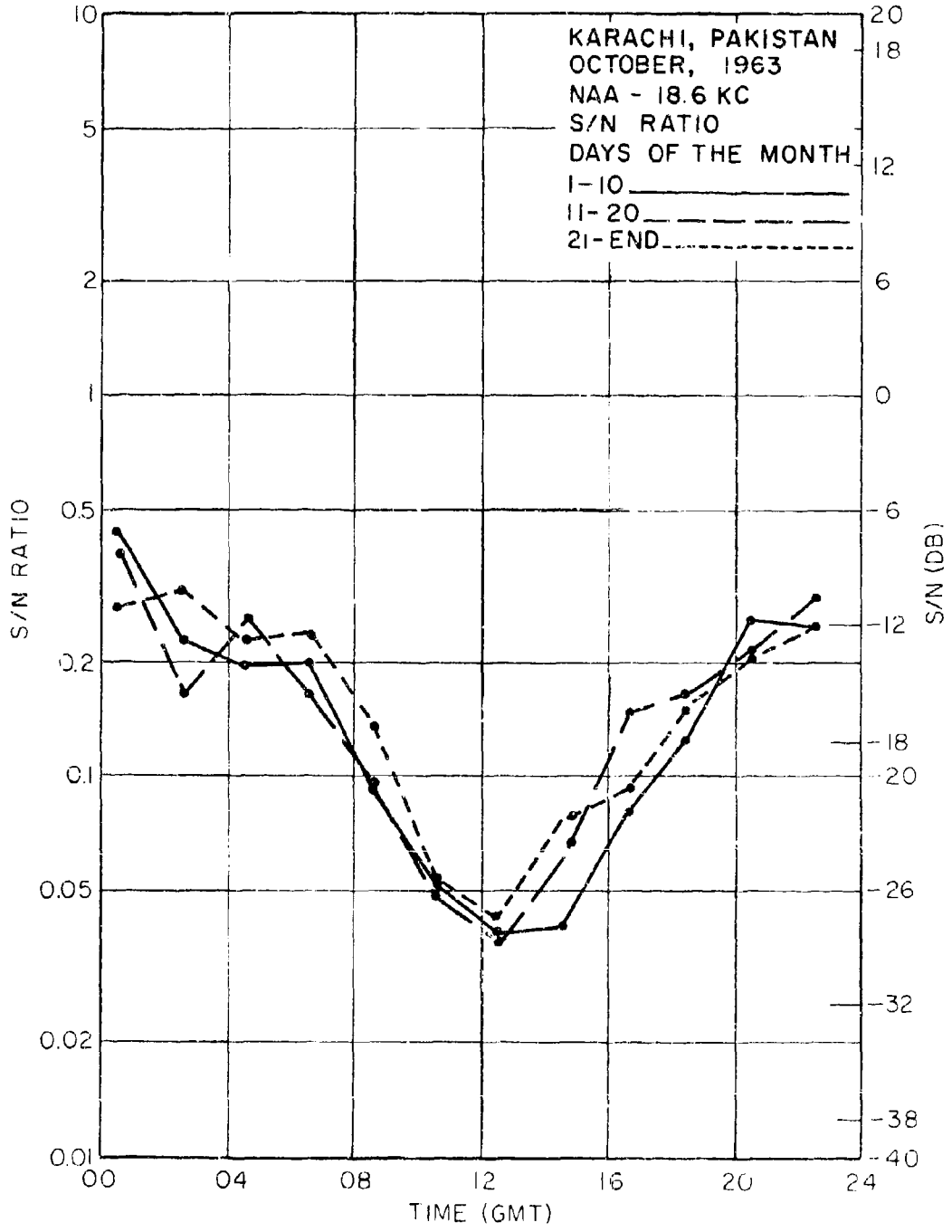
KARACHI, PAKISTAN
OCTOBER, 1963
NAA - 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 35

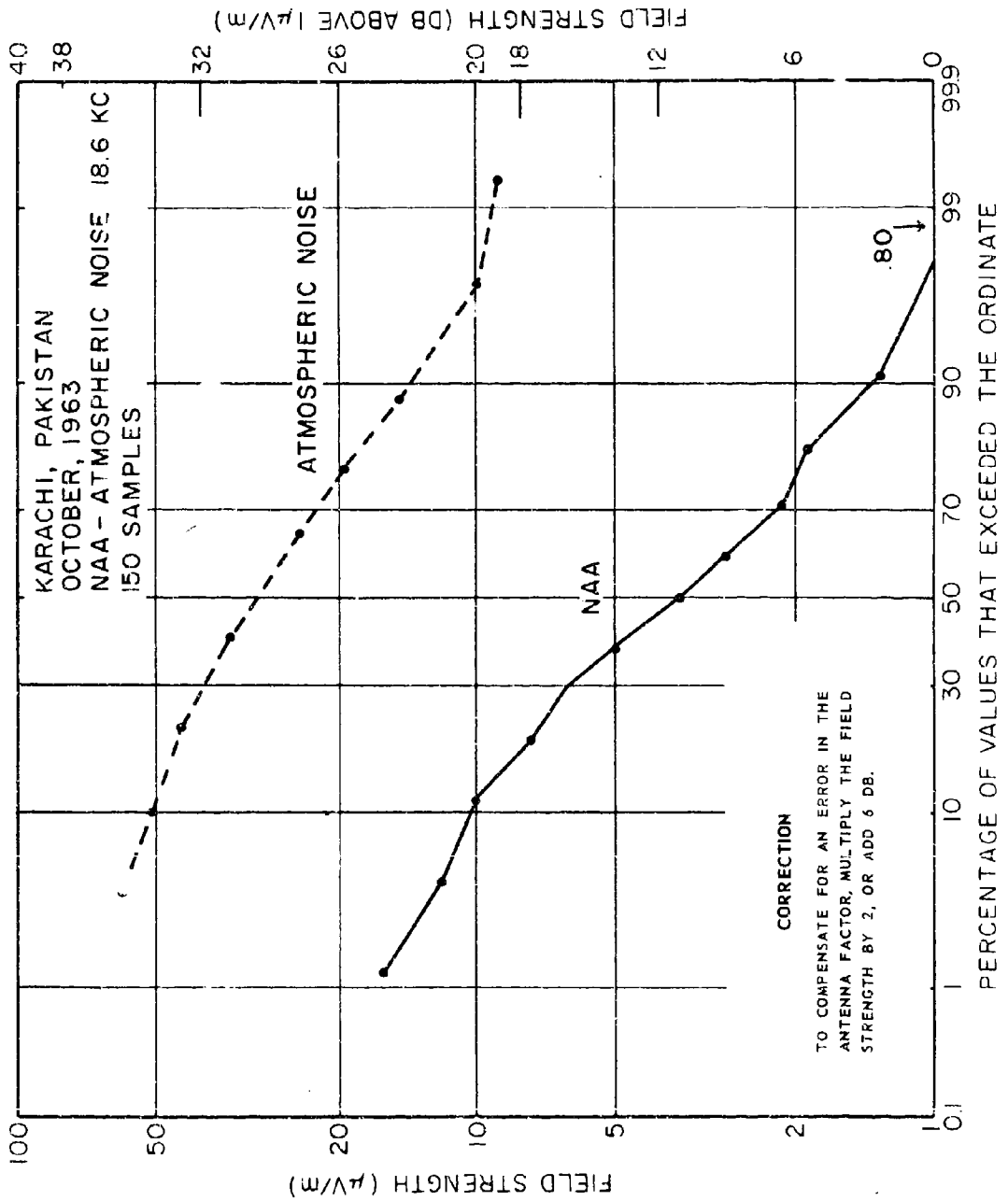
FIELD STRENGTH (DB ABOVE 1 μV/m)
40
38
32
26
20
18
12
6
0
KARACHI, PAKISTAN
OCTOBER, 1963
NAA - ATMOSPHERIC NOISE 18.6 KC
150 SAMPLES
ATMOSPHERIC NOISE
NAA
.80
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
100
50
20
10
5
2
1
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
0.1
1
10
30
50
70
90
99
99.9

Figure 36

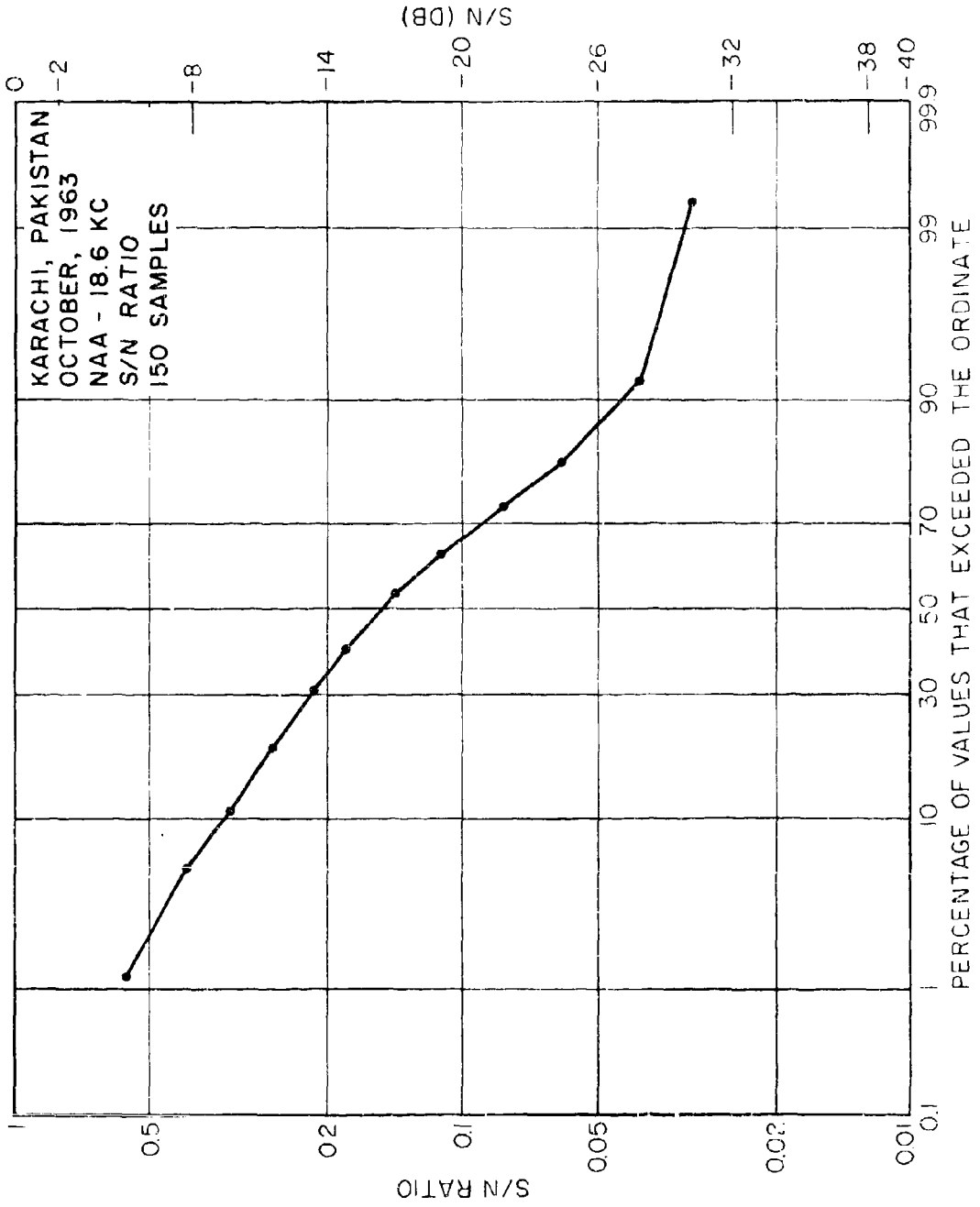
KARACHI, PAKISTAN
OCTOBER, 1963
NAA - 18.6 KC
S/N RATIO
150 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 37

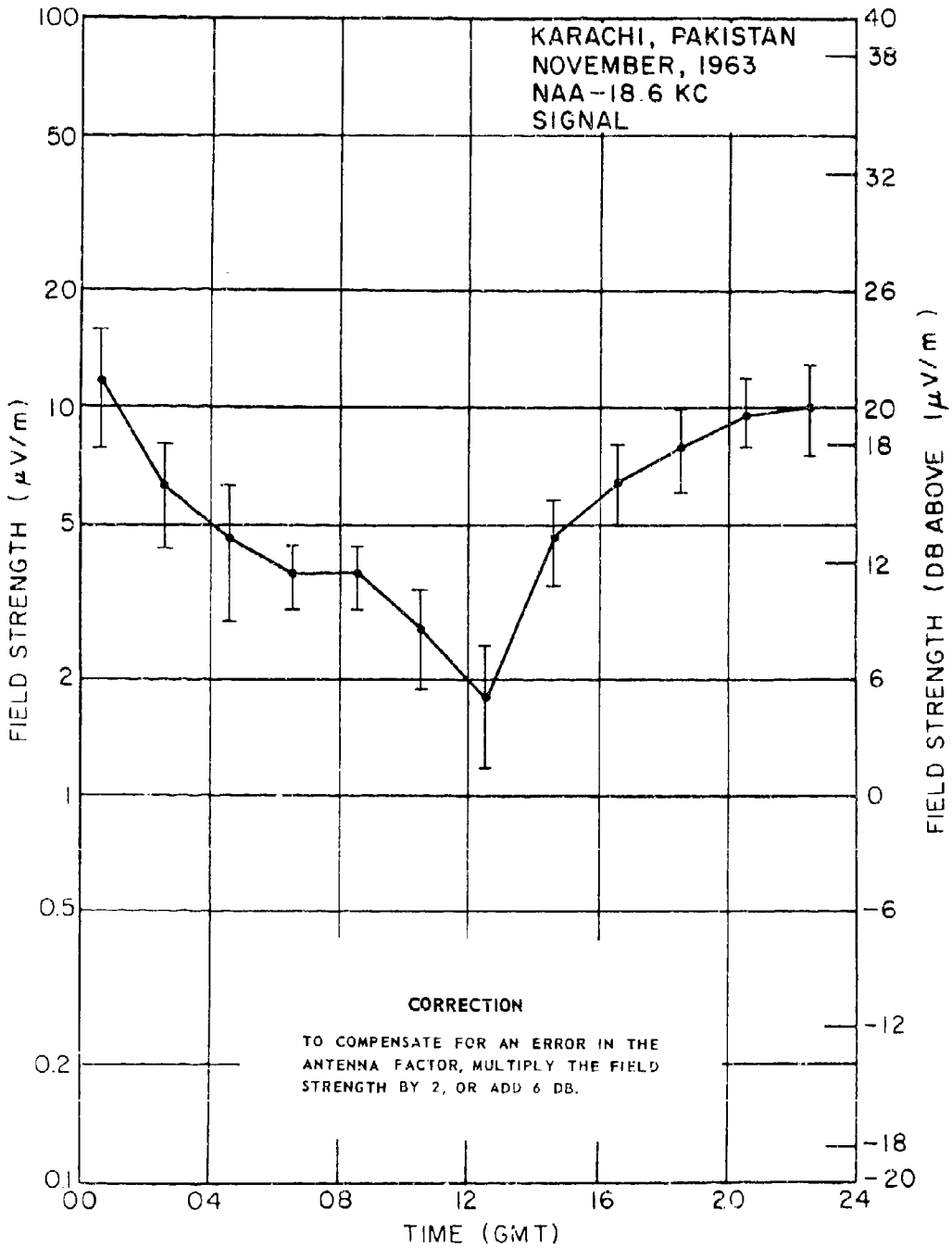
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA-18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 38

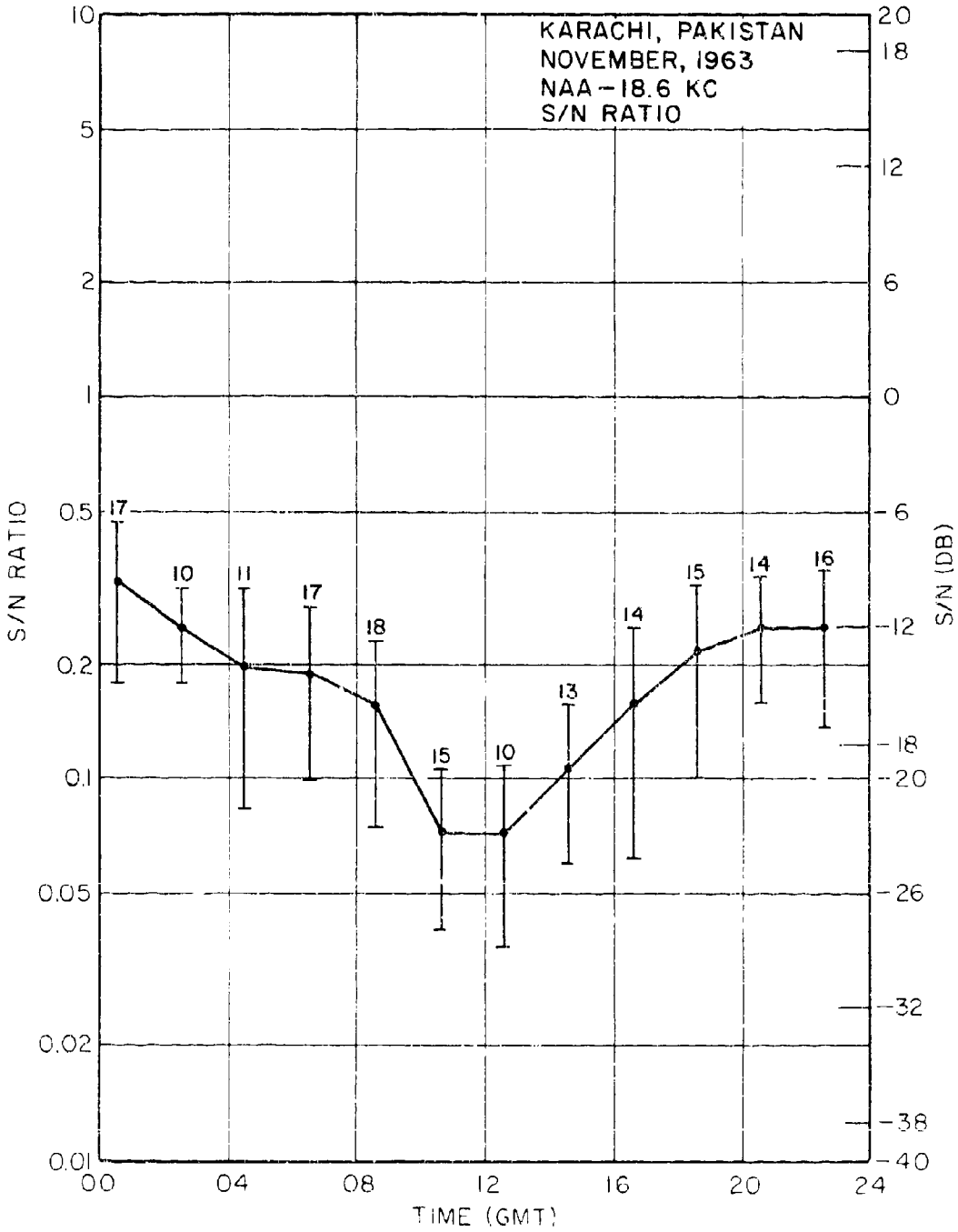
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA – 18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
17
10
11
17
18
15
10
13
14
15
14
16

Figure 39

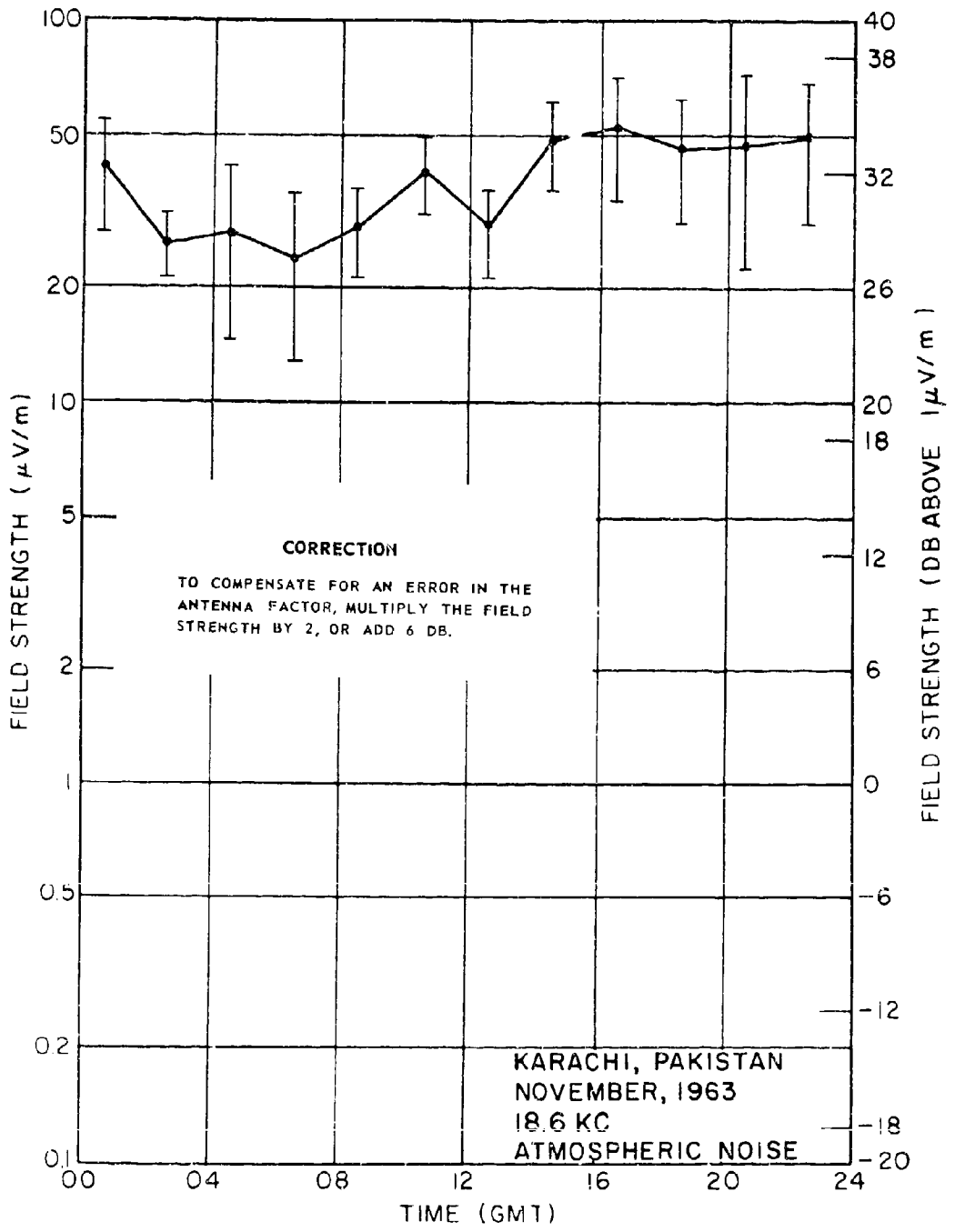
100
50
20
10
5
2
1
0.5
0.2
0.1
FIELD STRENGTH (μV/m)
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
FIELD STRENGTH (DB ABOVE 1μV/m)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
NOVEMBER, 1963
18.6 KC
ATMOSPHERIC NOISE
00
04
08
12
16
20
24
TIME (GMT)

Figure 46

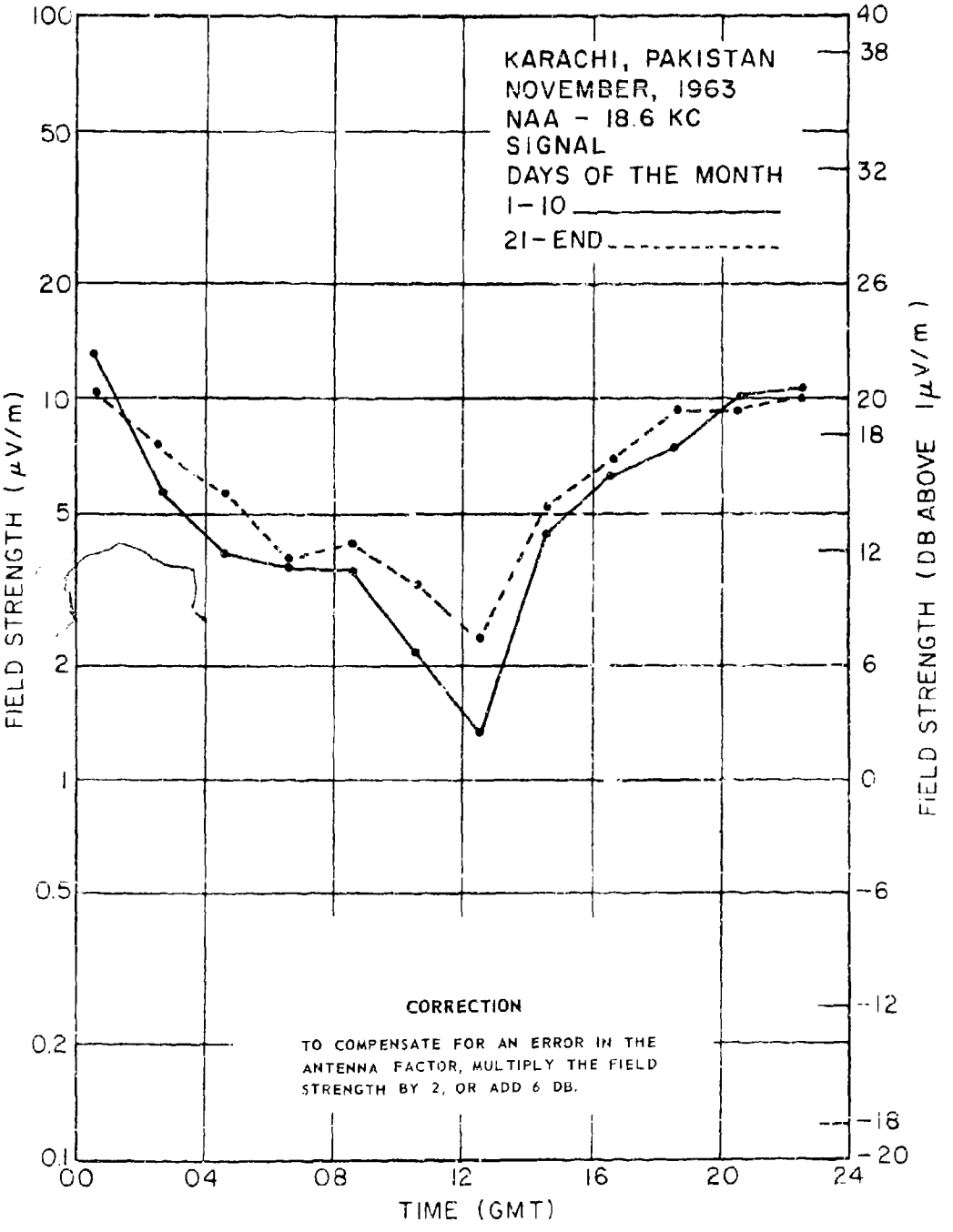
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
21-END
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 41

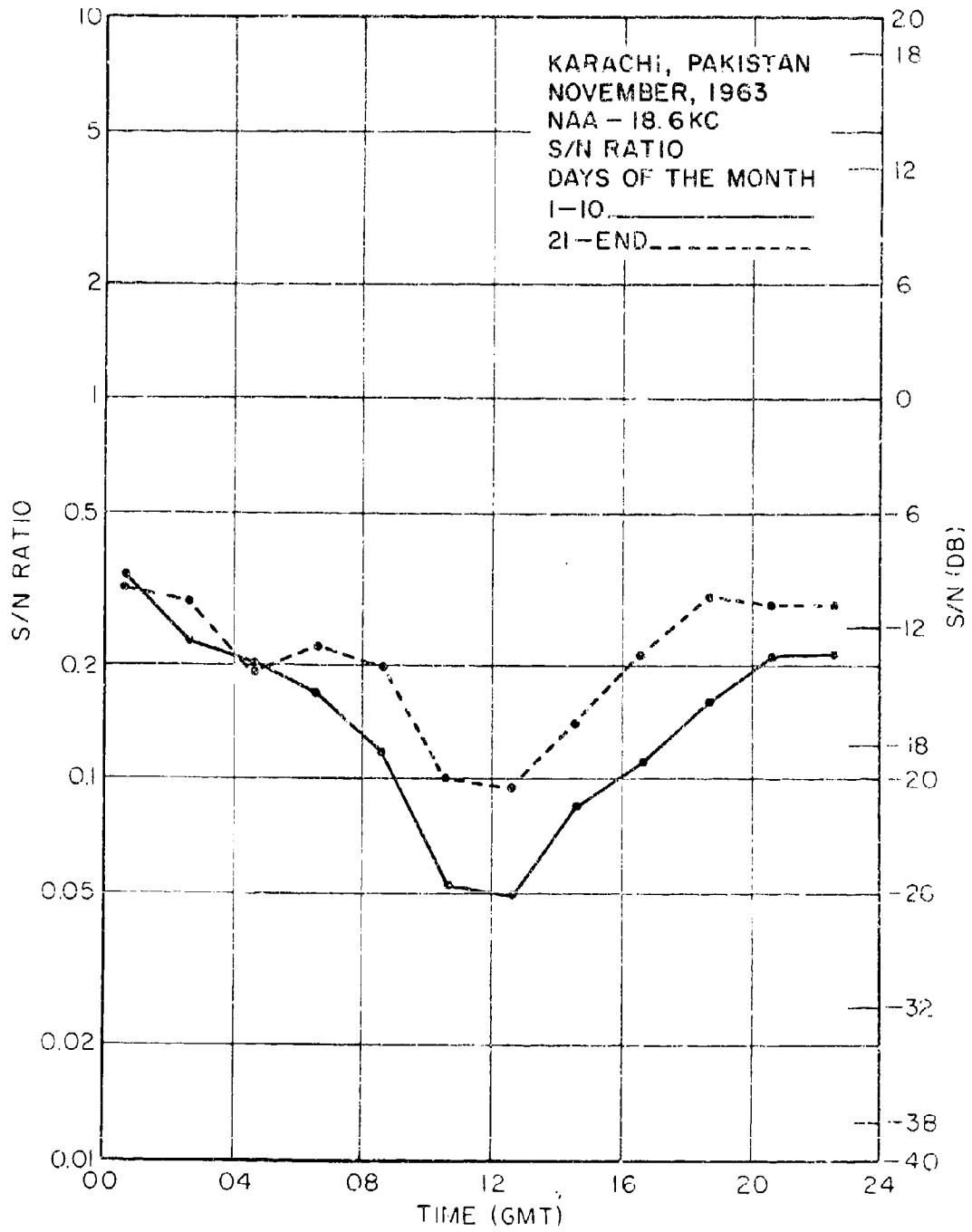
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA – 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1–10
21–END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 42

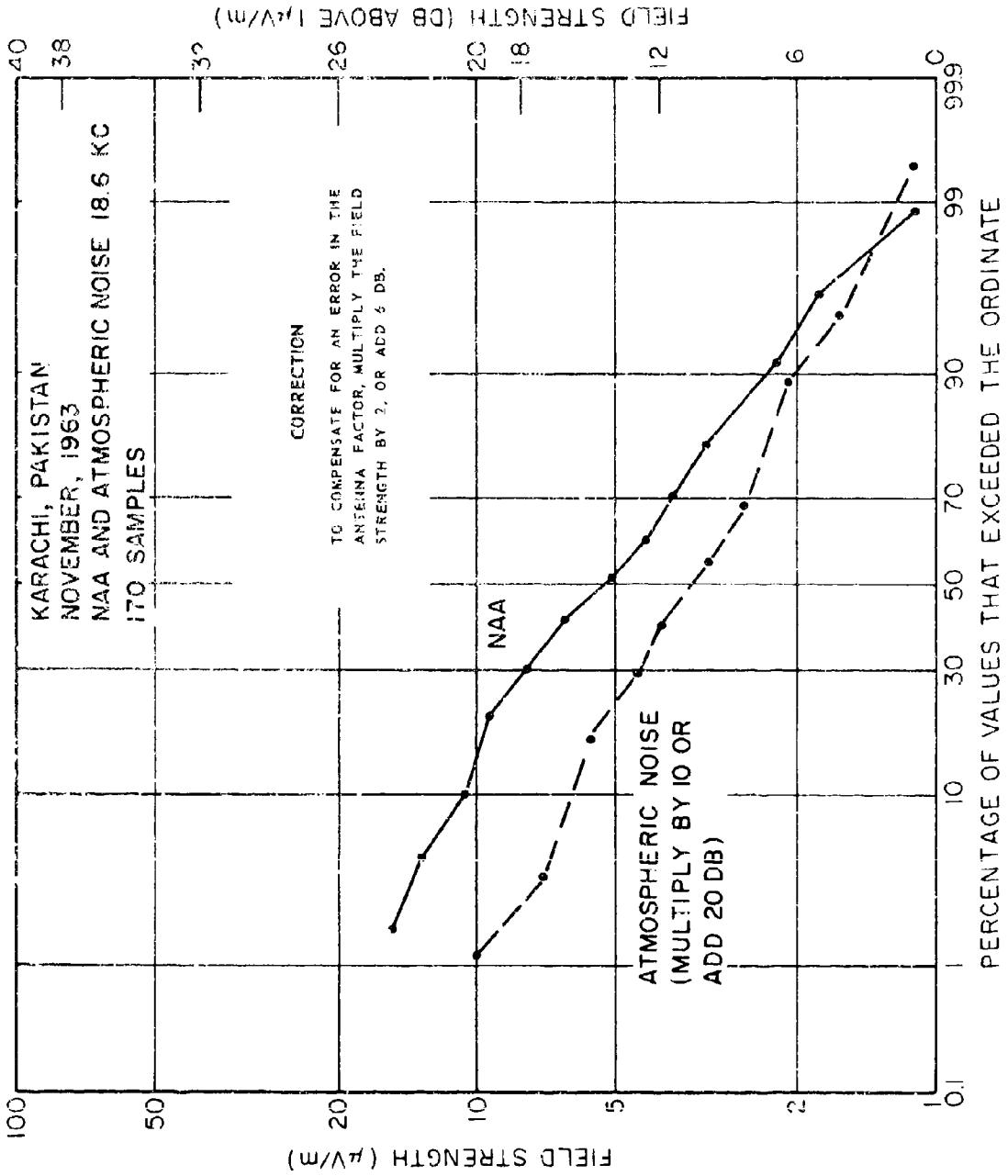
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA AND ATMOSPHERIC NOISE 18.6 KC
170 SAMPLES
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
NAA
ATMOSPHERIC NOISE
(MULTIPLY BY 10 OR
ADD 20 DB)
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
999
99
90
70
50
30
10
1

Figure 43

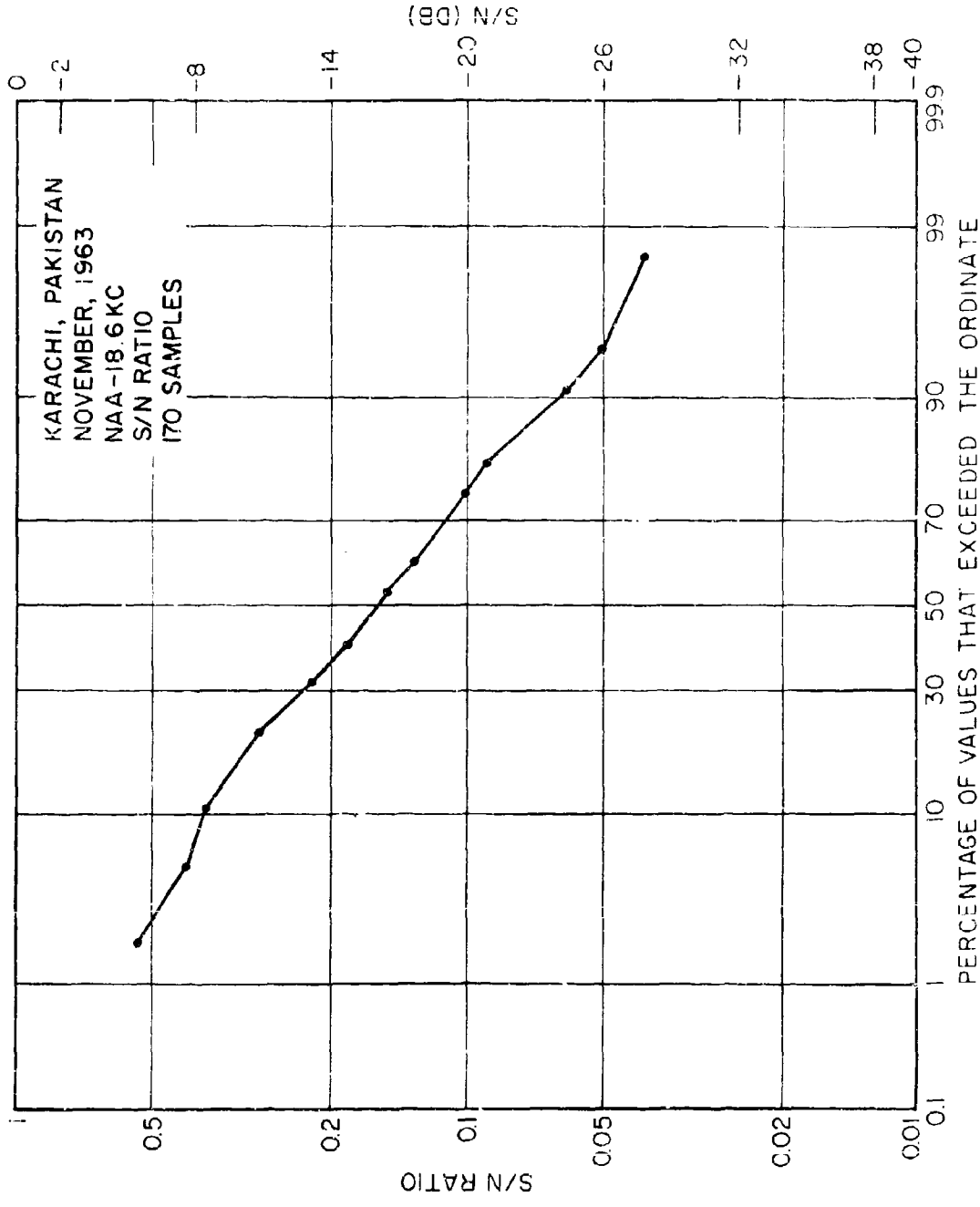
KARACHI, PAKISTAN
NOVEMBER, 1963
NAA-18.6 KC
S/N RATIO
170 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 44

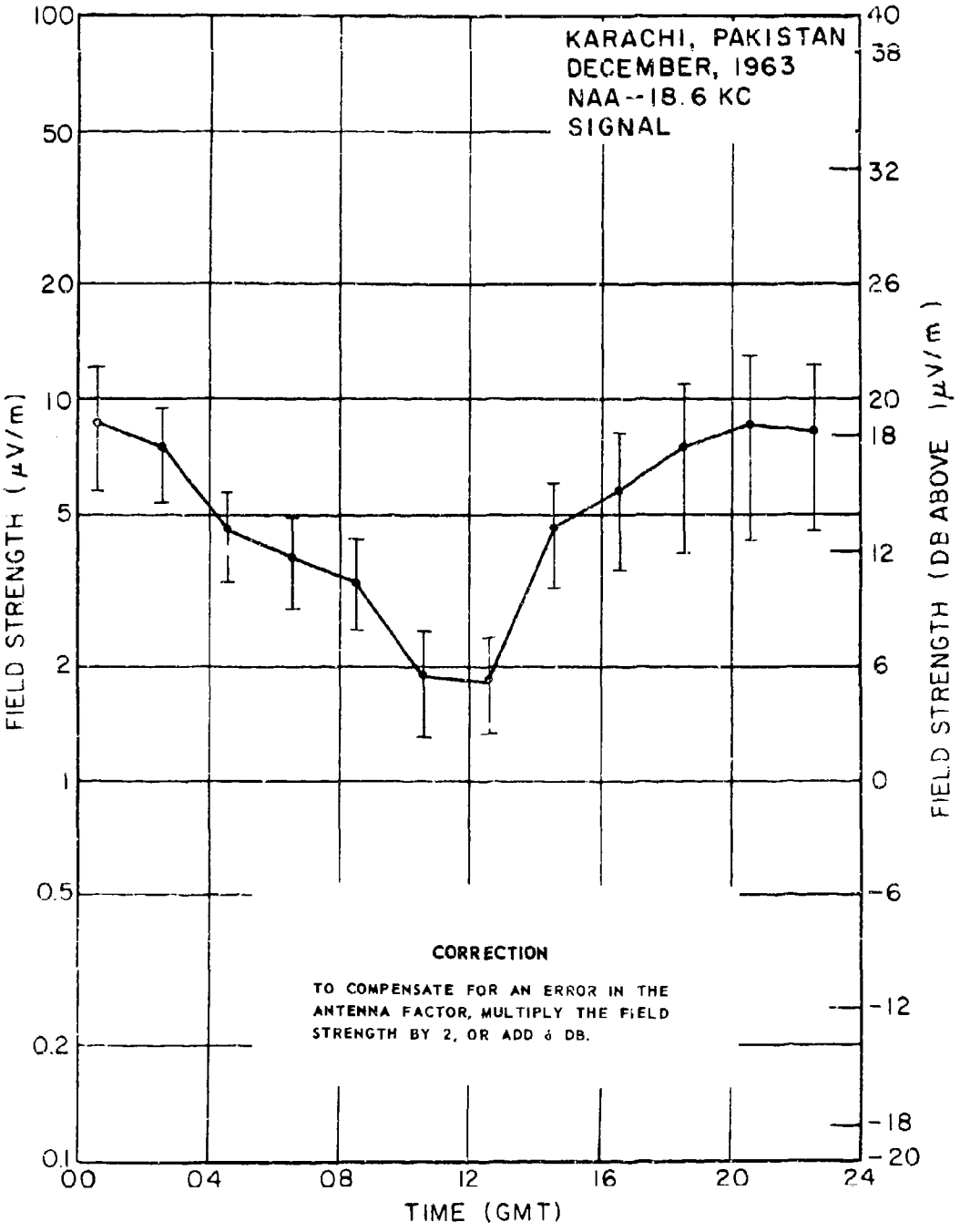
KARACHI, PAKISTAN
DECEMBER, 1963
NAA--18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 45

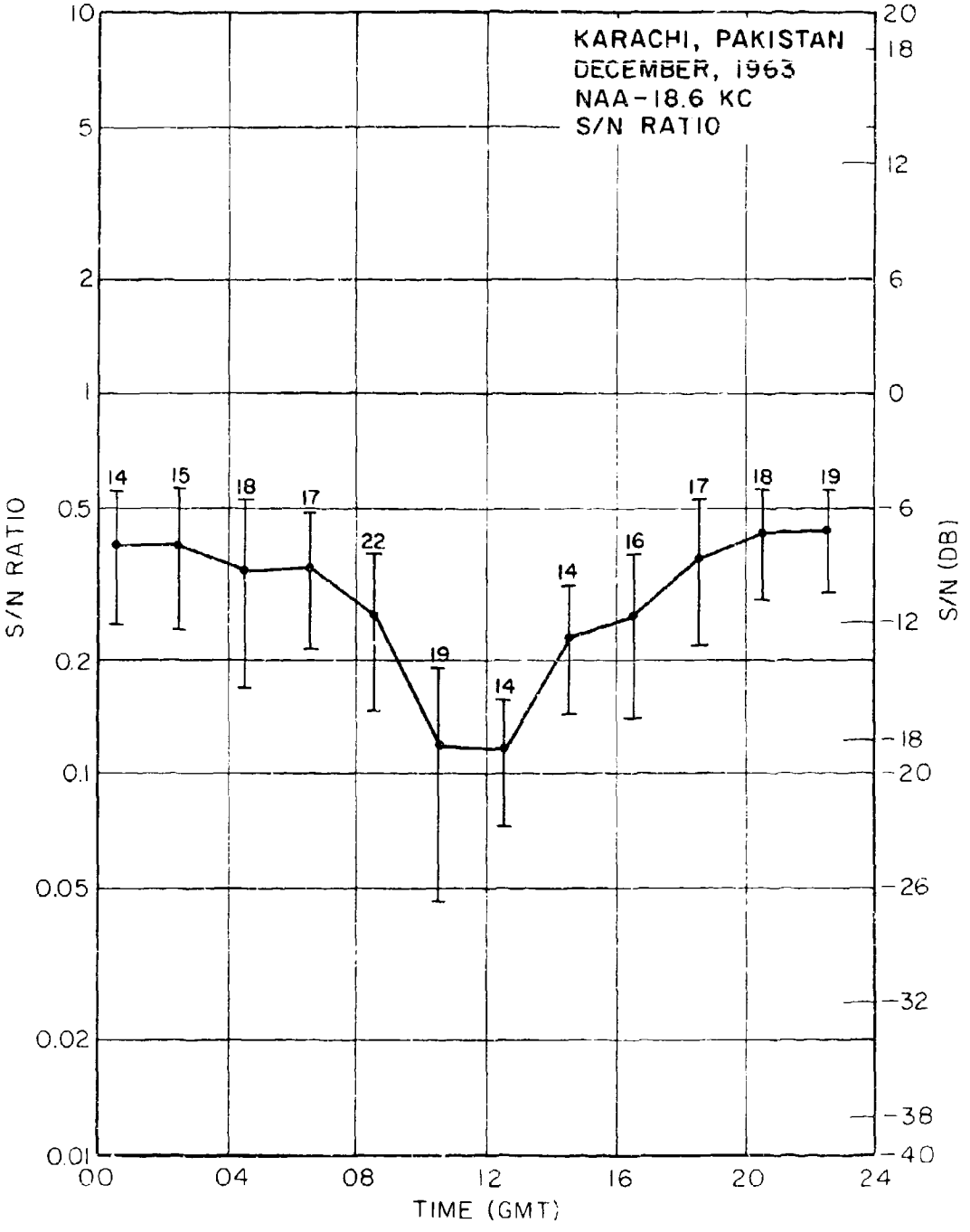
KARACHI, PAKISTAN
DECEMBER, 1963
NAA-18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
14
15
18
17
22
19
14
14
16
17
18
19

Figure 46

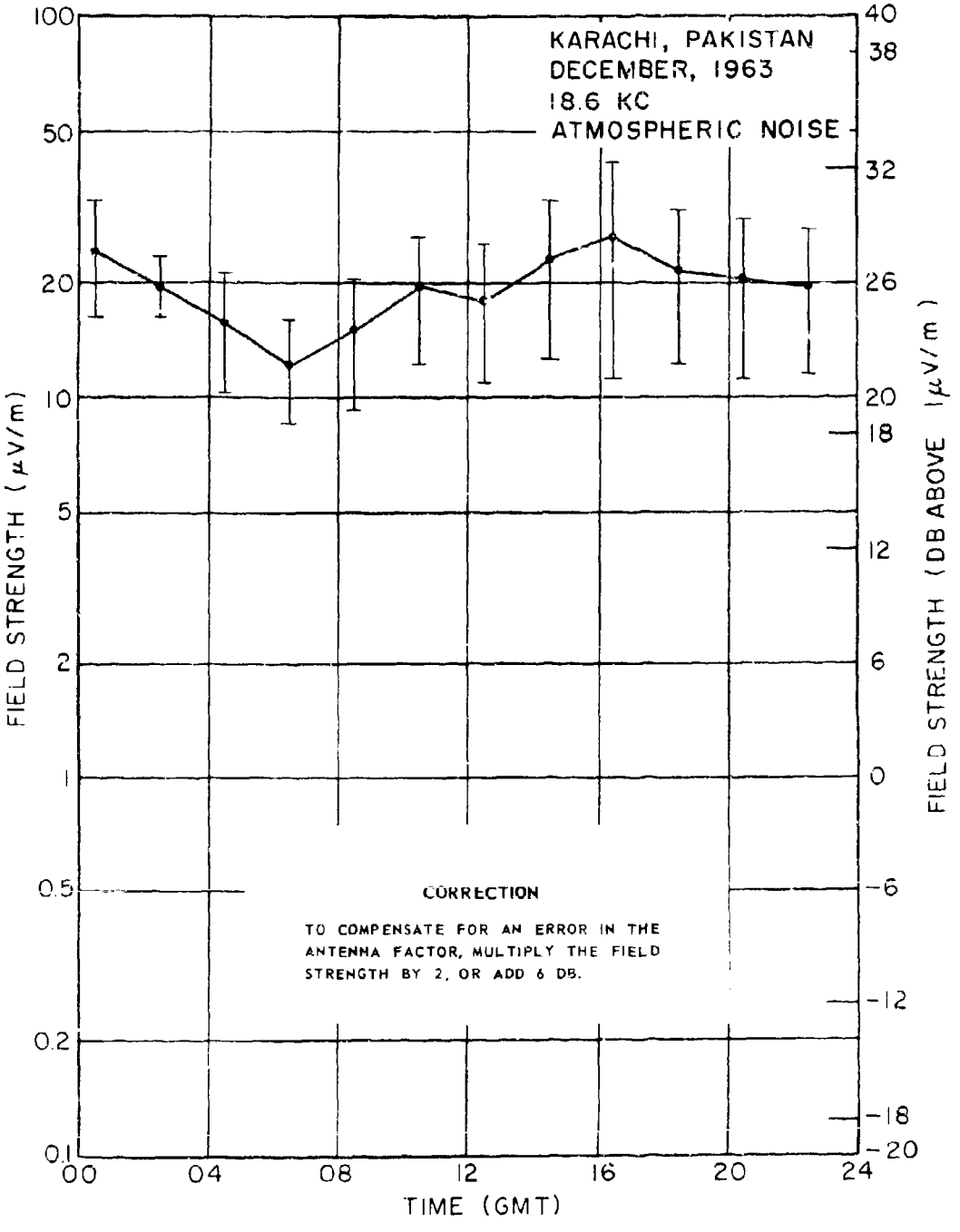
KARACHI, PAKISTAN
DECEMBER, 1963
18.6 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 47

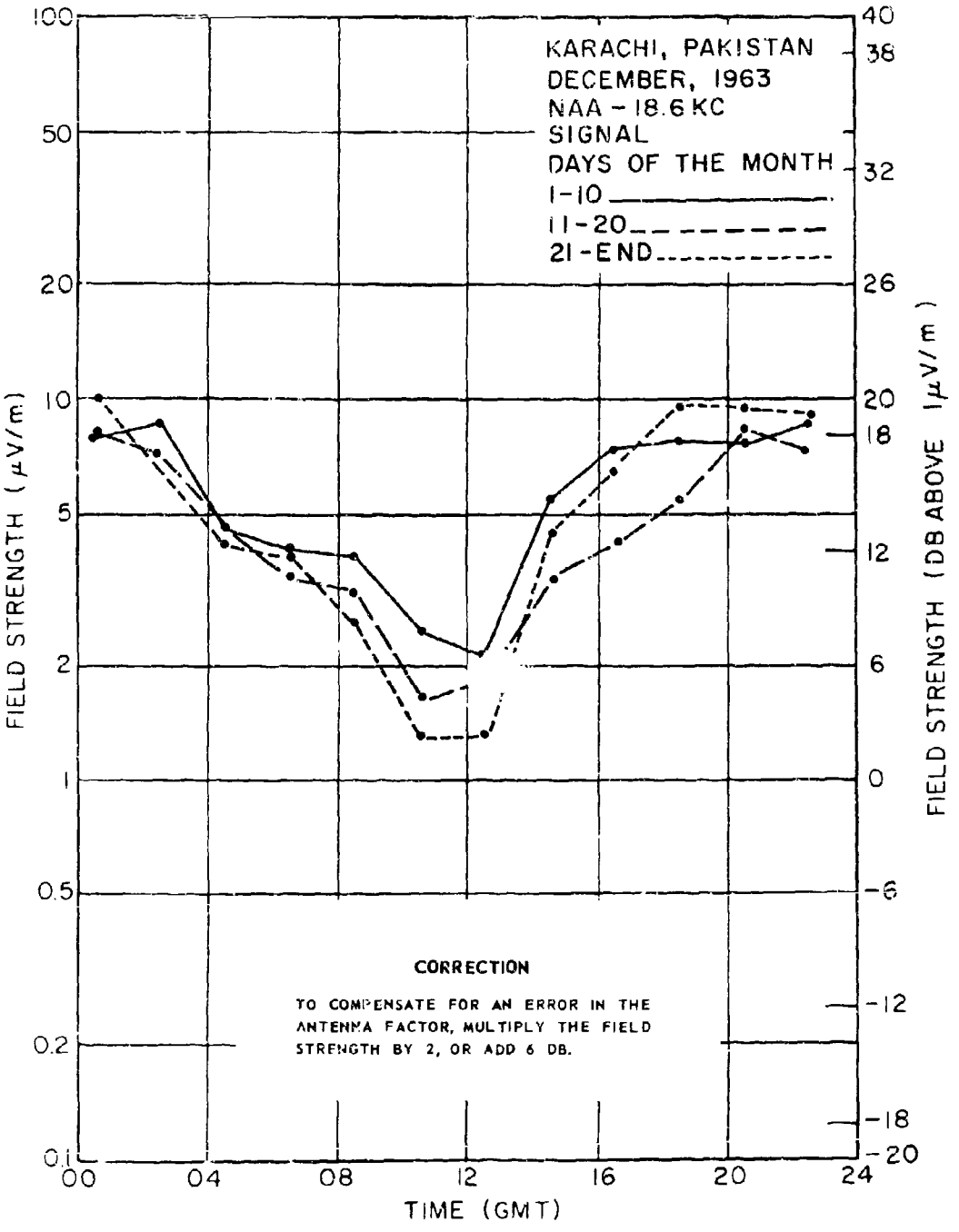
KARACHI, PAKISTAN
DECEMBER, 1963
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 48

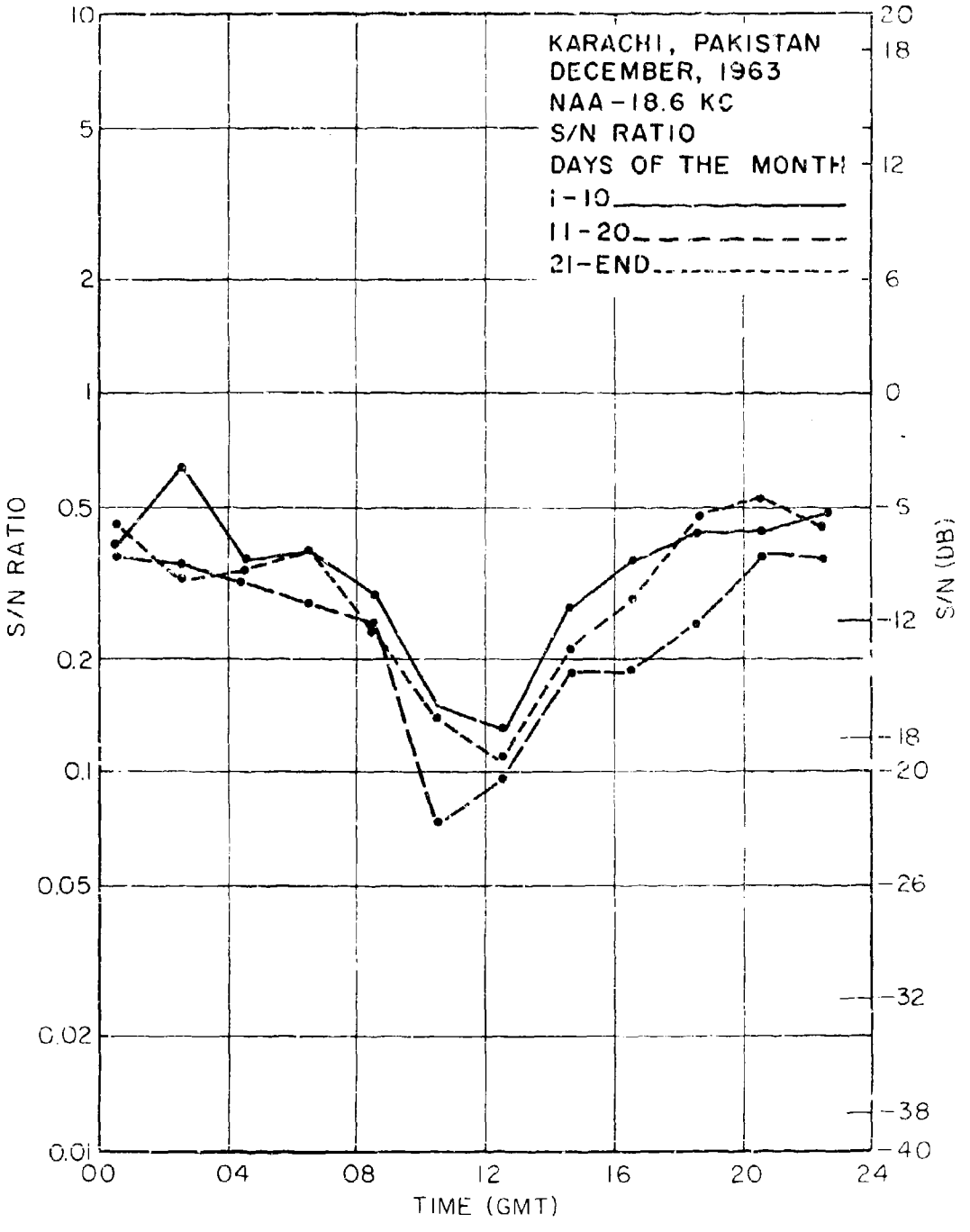
KARACHI, PAKISTAN
DECEMBER, 1963
NAA-18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 49

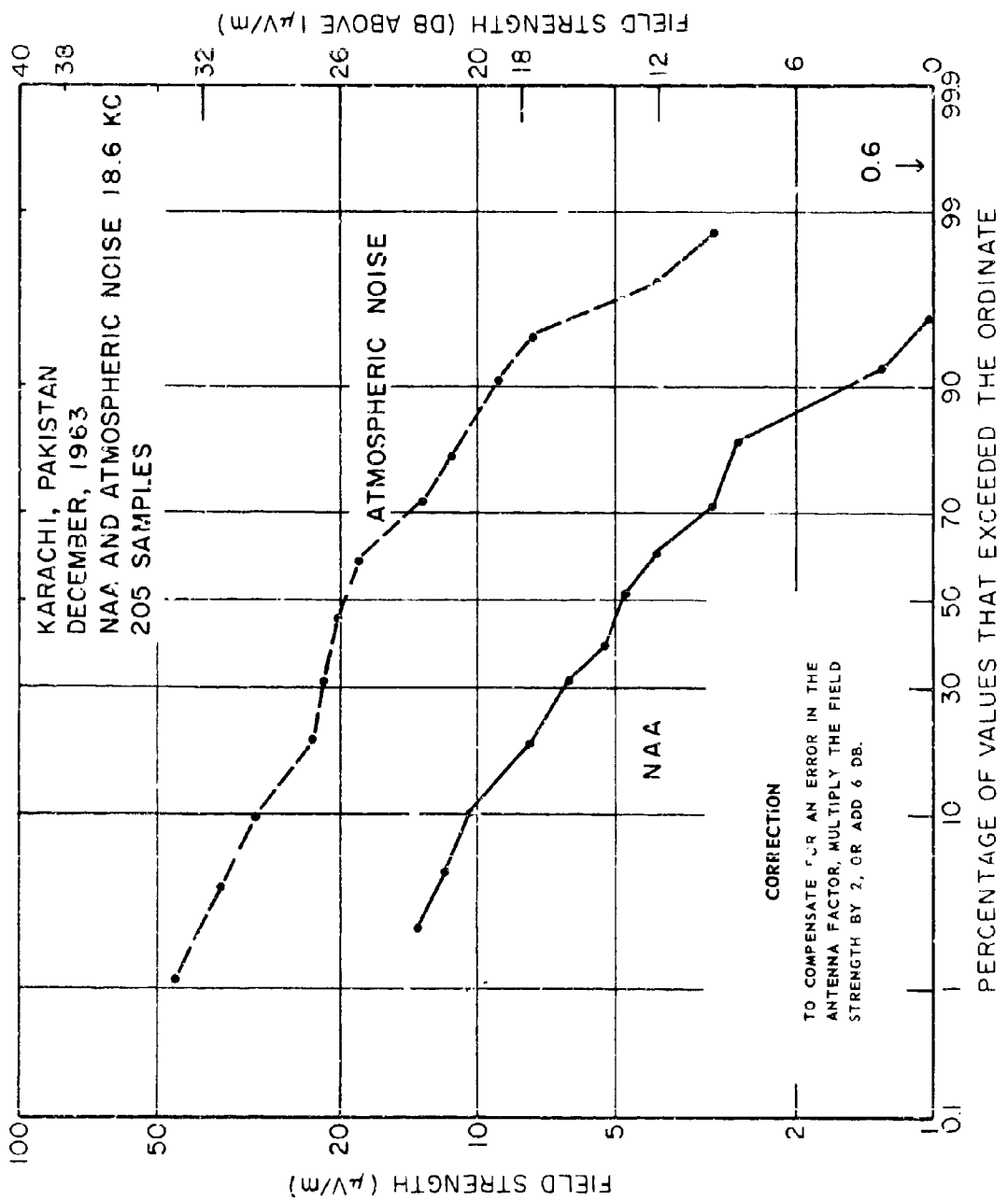
FIELD STRENGTH (DB ABOVE 1 μV/m)
40
38
32
26
20
18
12
6
0
FIELD STRENGTH (μV/m)
100
50
20
10
5
2
1
0.1
KARACHI, PAKISTAN
DECEMBER, 1963
NAA AND ATMOSPHERIC NOISE 18.6 KC
205 SAMPLES
ATMOSPHERIC NOISE
NAA
0.6
999
99
90
70
50
30
10
1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 50

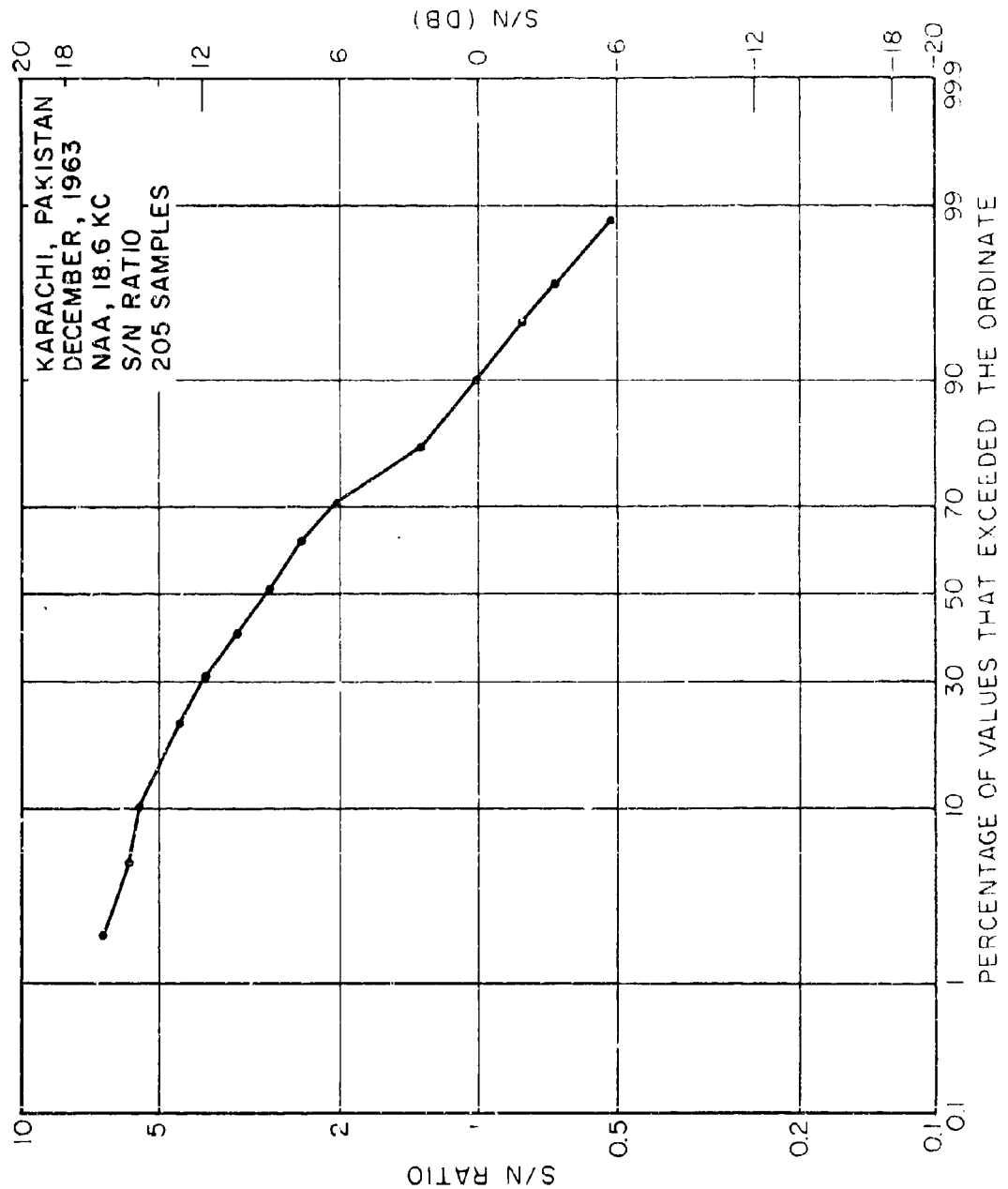
KARACHI, PAKISTAN
DECEMBER, 1963
NAA, 18.6 KC
S/N RATIO
205 SAMPLES
S/N (DB)
20
18
12
6
0
-6
-12
-18
-20
S/N RATIO
10
5
2
1
0.5
0.2
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 51

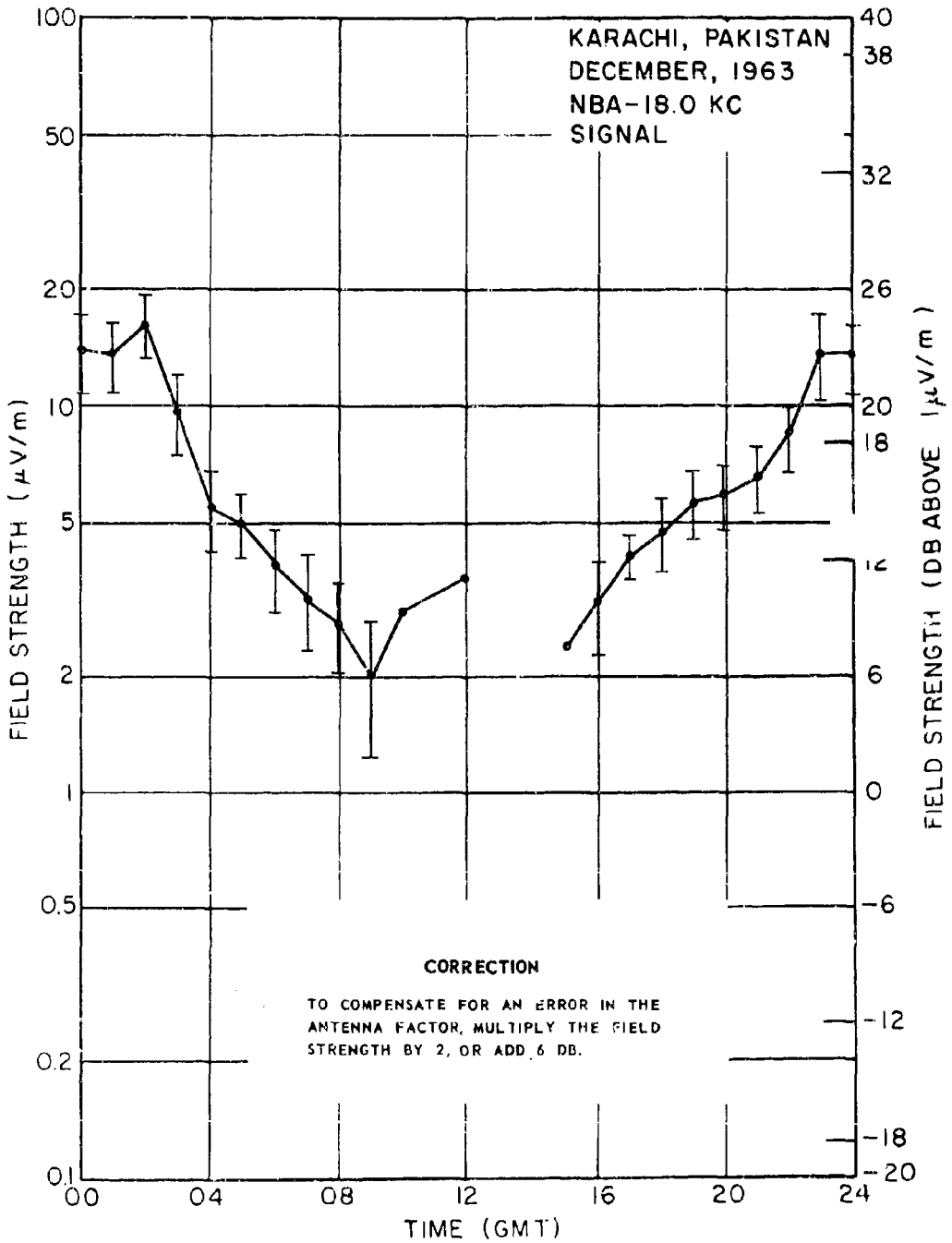
KARACHI, PAKISTAN
DECEMBER, 1963
NBA-18.0 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 52

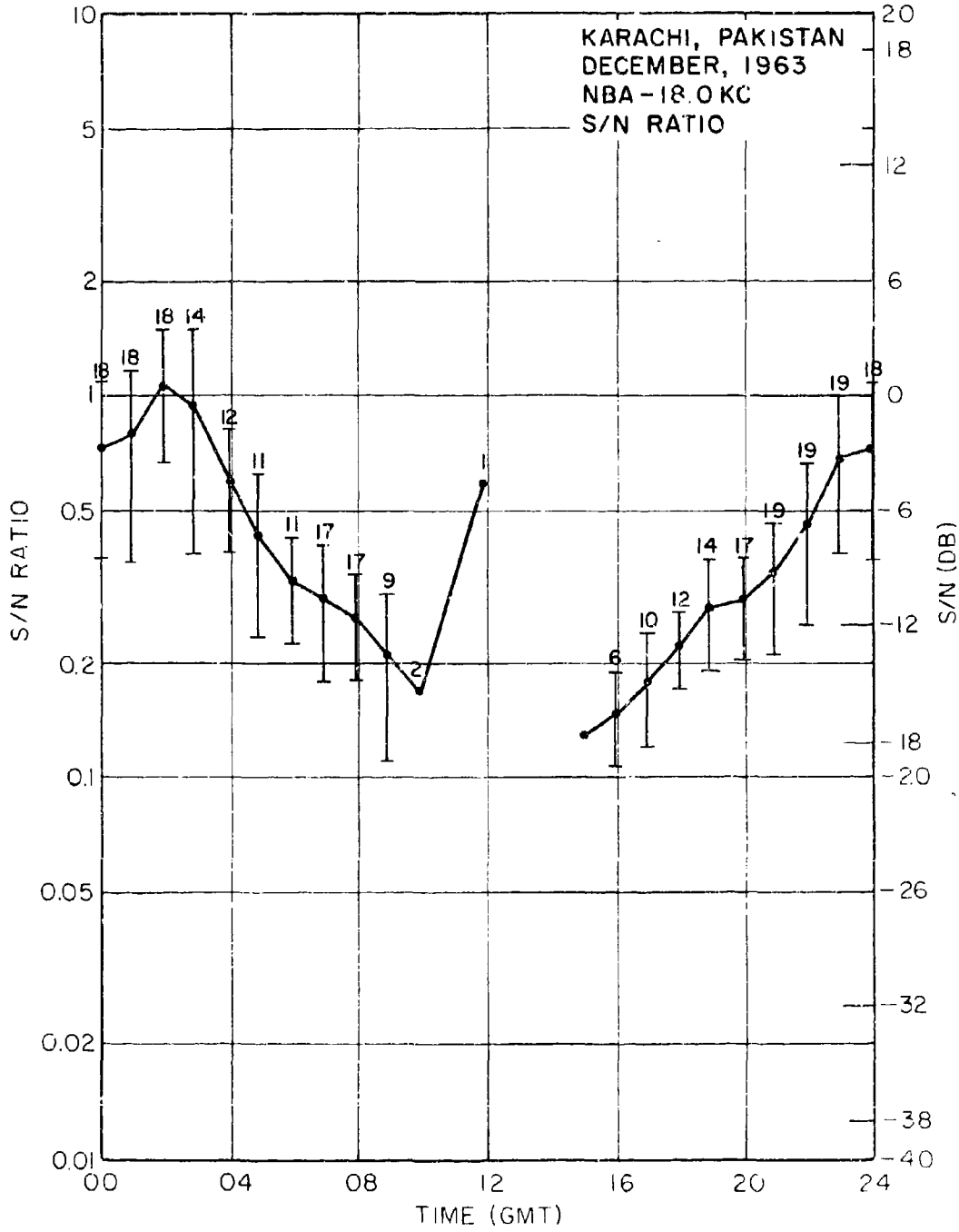
KARACHI, PAKISTAN
DECEMBER, 1963
NBA - 18.0 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 53

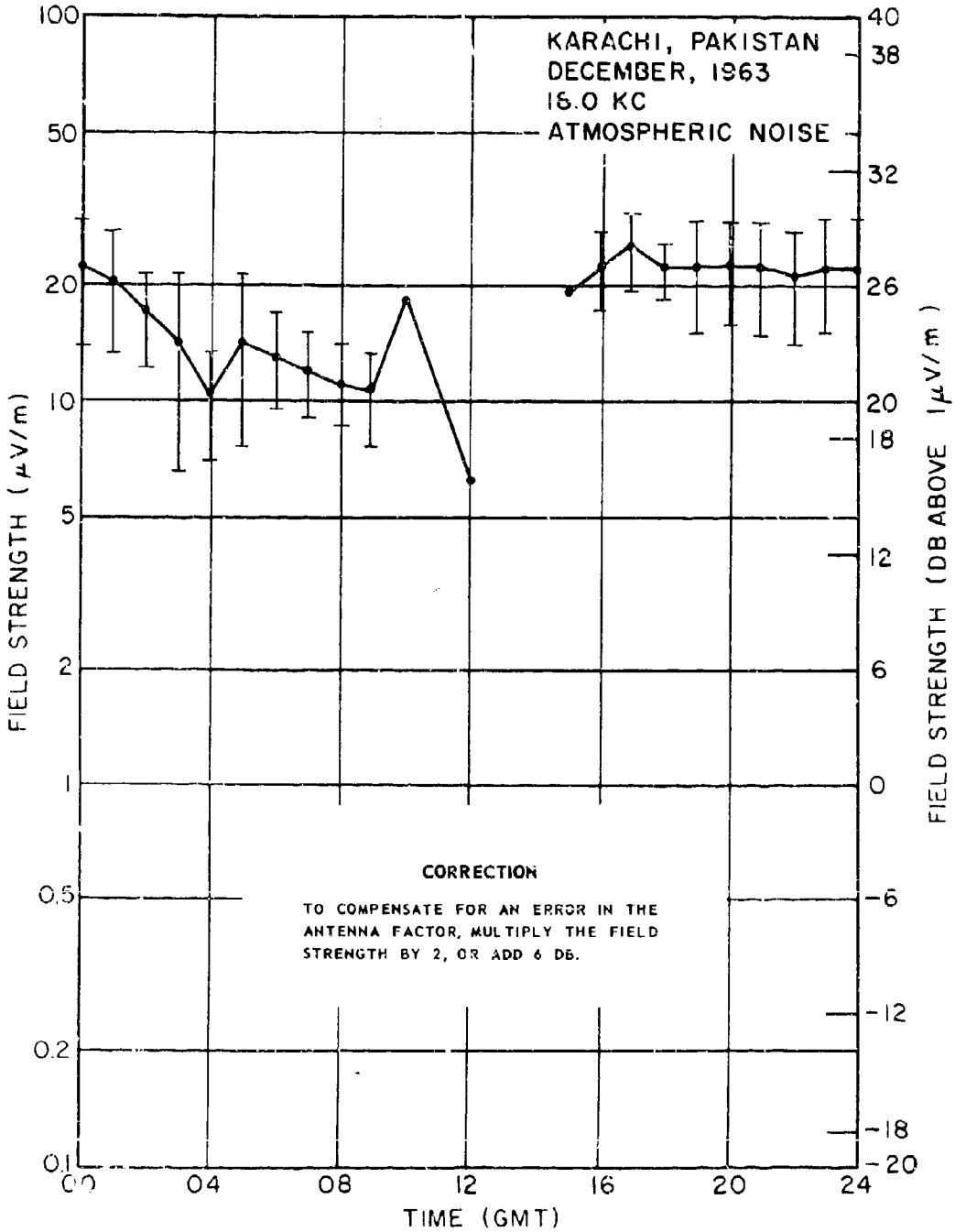
KARACHI, PAKISTAN
DECEMBER, 1963
15.0 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 54

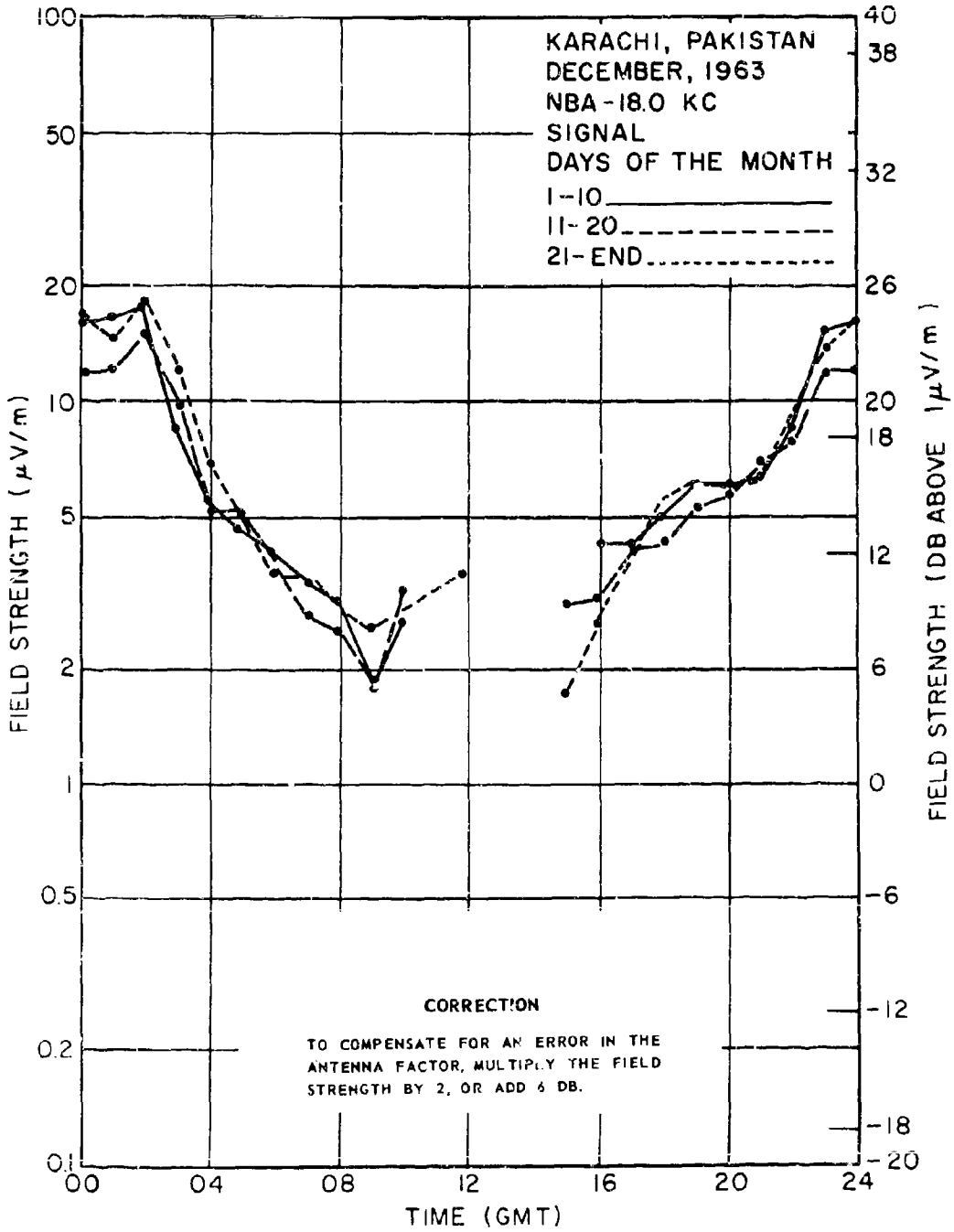
KARACHI, PAKISTAN
DECEMBER, 1963
NBA-18.0 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 55

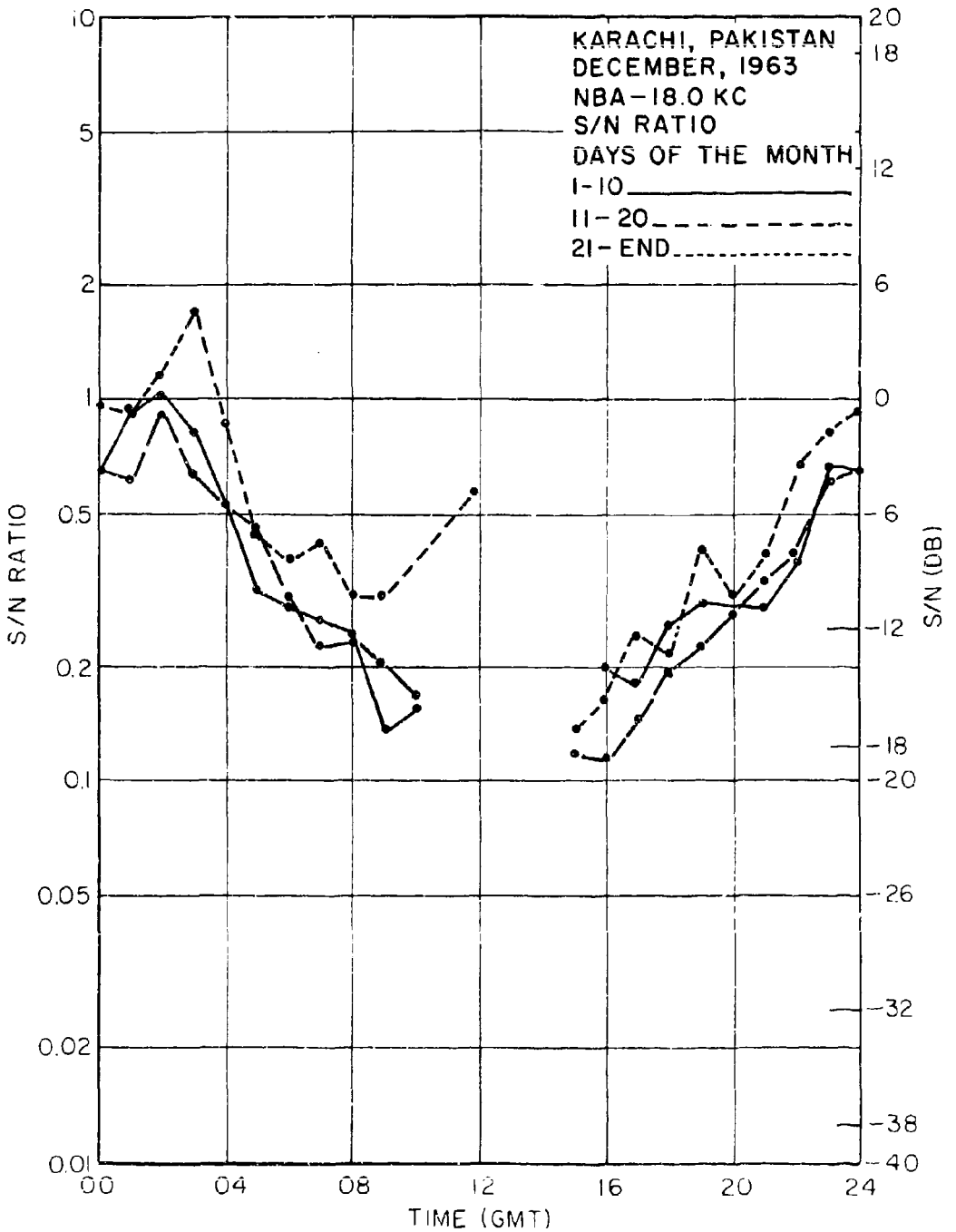
KARACHI, PAKISTAN
DECEMBER, 1963
NBA-18.0 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 56

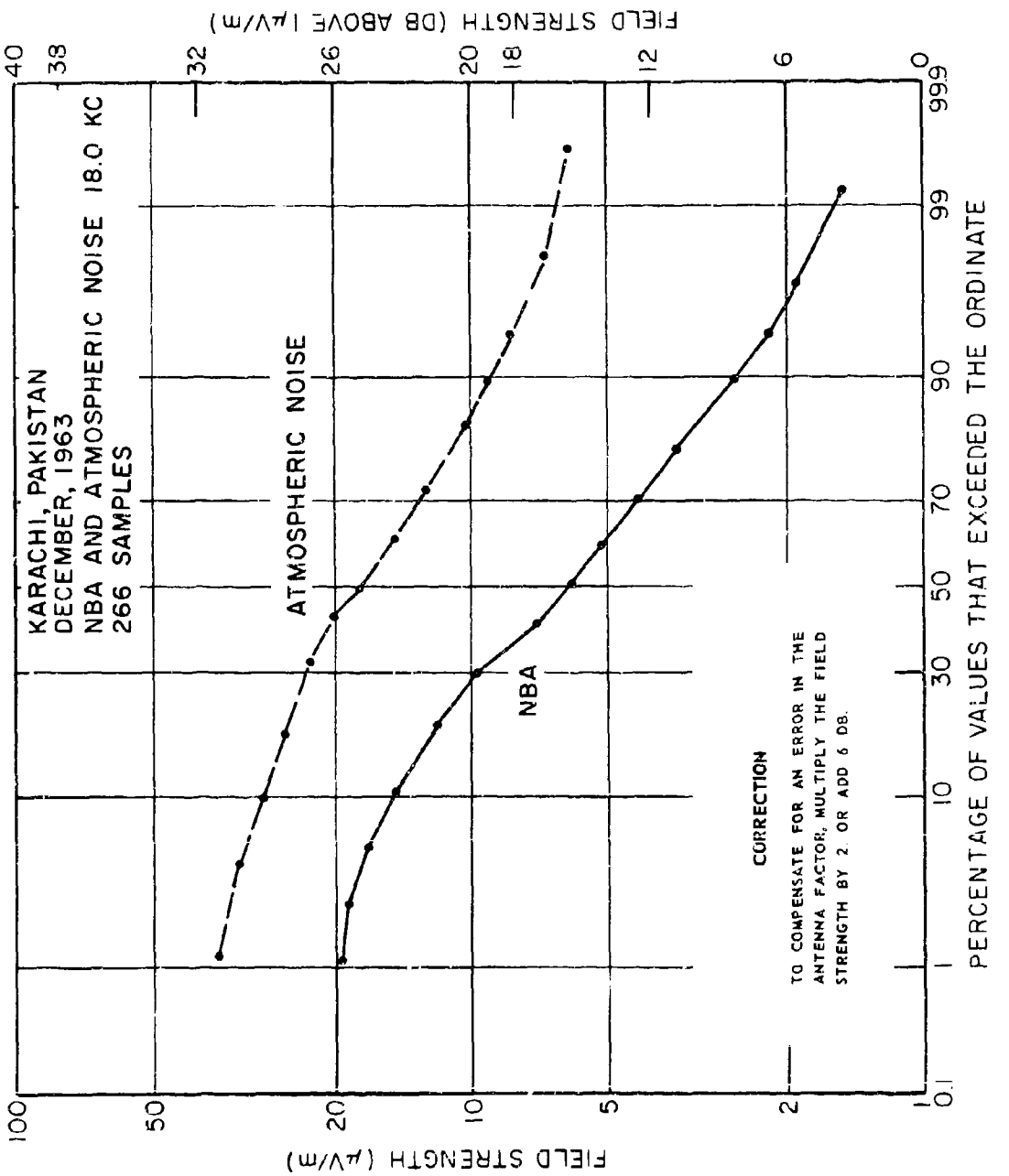
KARACHI, PAKISTAN
DECEMBER, 1963
NBA AND ATMOSPHERIC NOISE 18.0 KC
266 SAMPLES
ATMOSPHERIC NOISE
NBA
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2 OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
99.9
99
90
70
50
30
10
1

Figure 57

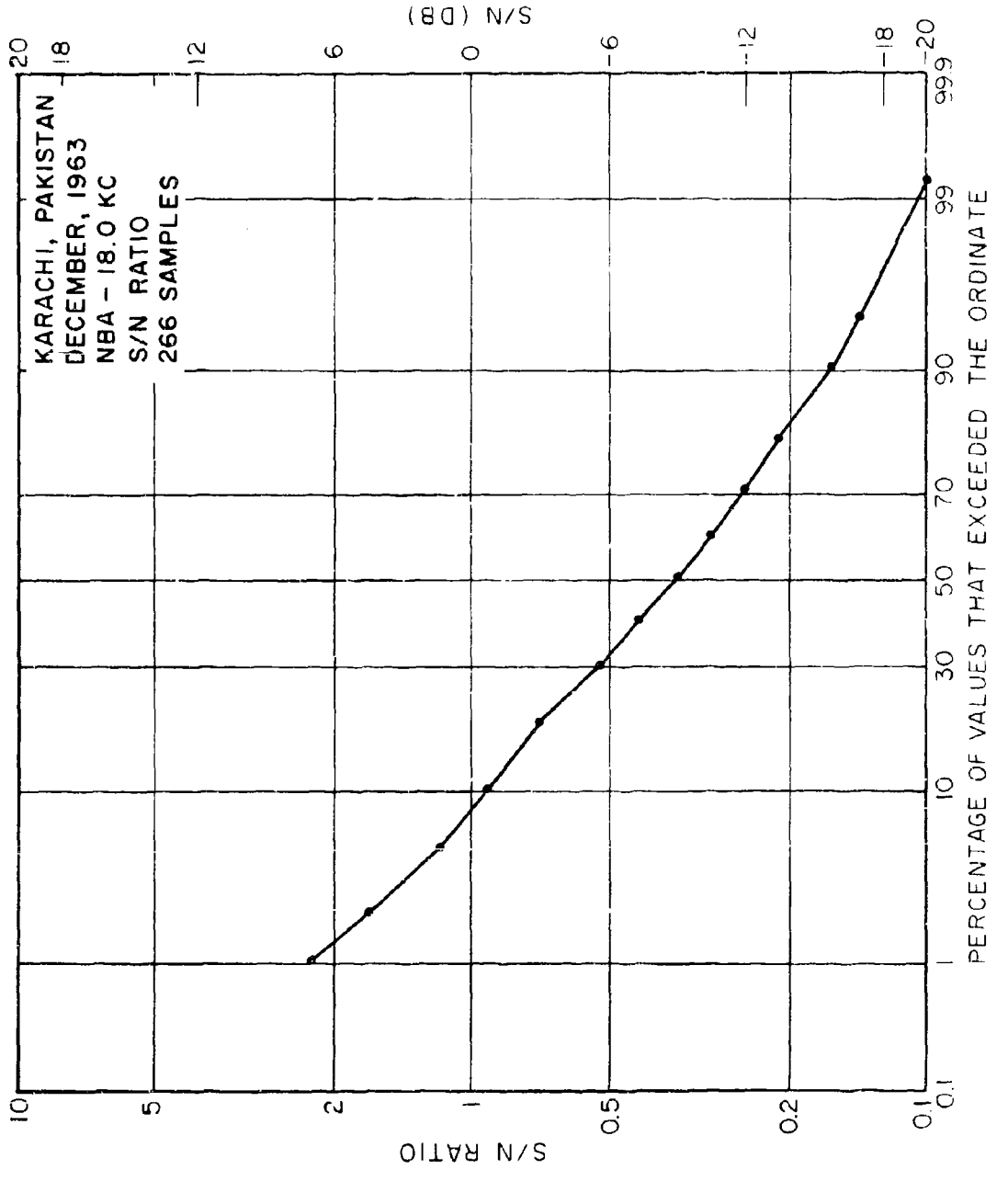
KARACHI, PAKISTAN
DECEMBER, 1963
NBA - 18.0 KC
S/N RATIO
266 SAMPLES
S/N (DB)
20
18
12
6
0
-6
-12
-18
-20
S/N RATIO
10
5
2
1
0.5
0.2
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 58

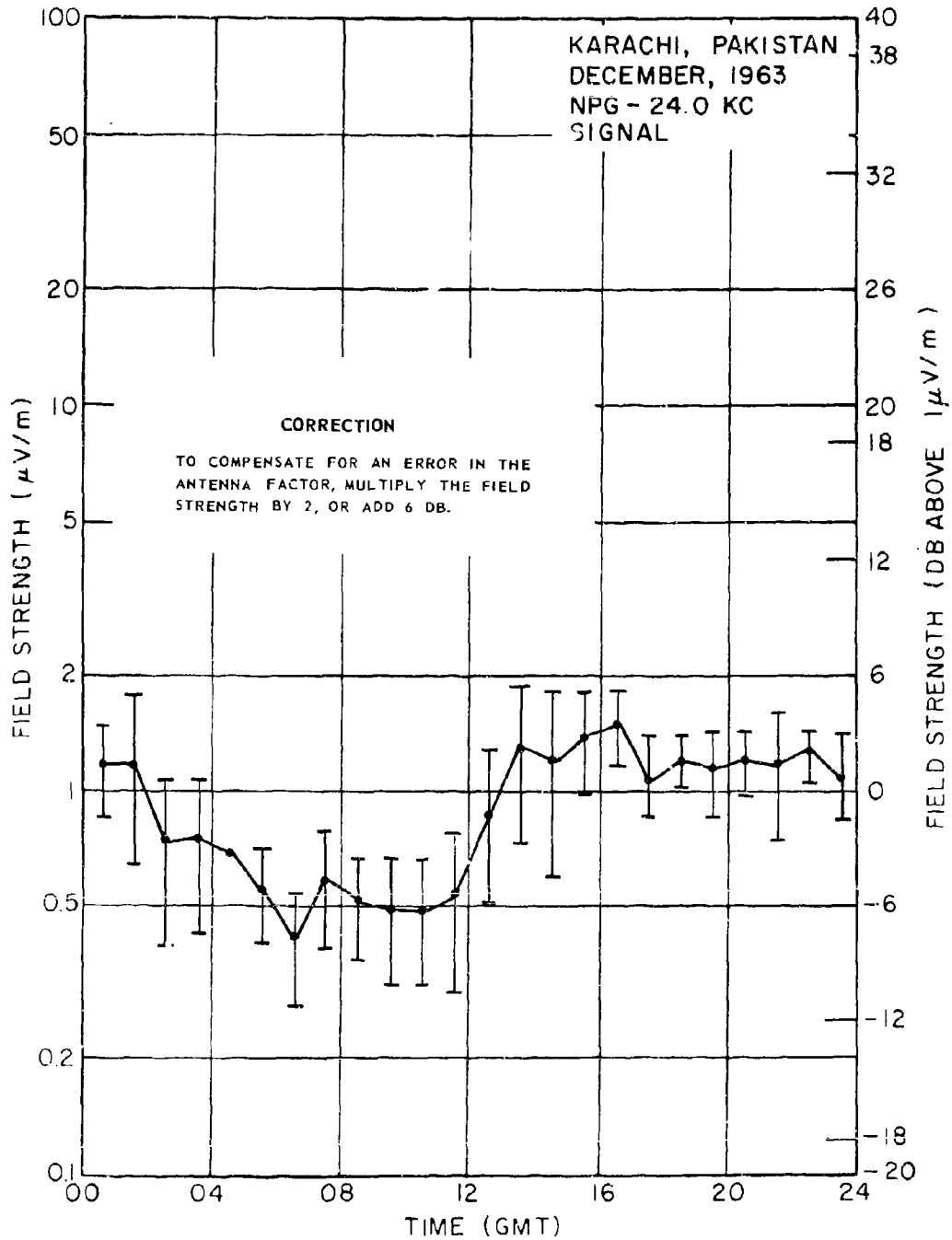
KARACHI, PAKISTAN
DECEMBER, 1963
NPG - 24.0 KC
SIGNAL
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 59

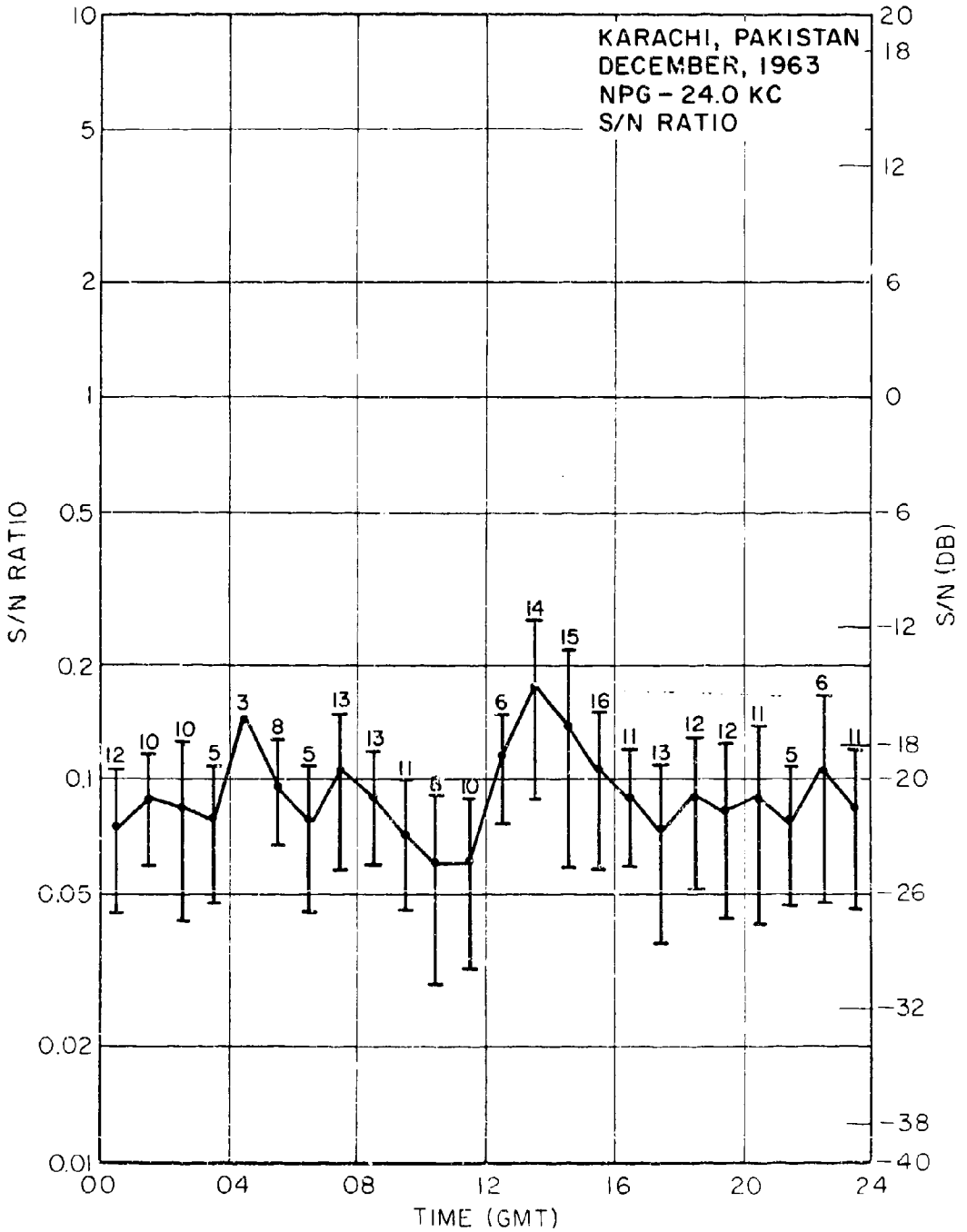
KARACHI, PAKISTAN
DECEMBER, 1963
NPG – 24.0 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
12 10 10 5 3 8 5 13 13 11 6 10 6 14 15 16 11 13 12 12 11 5 6 11

Figure 60

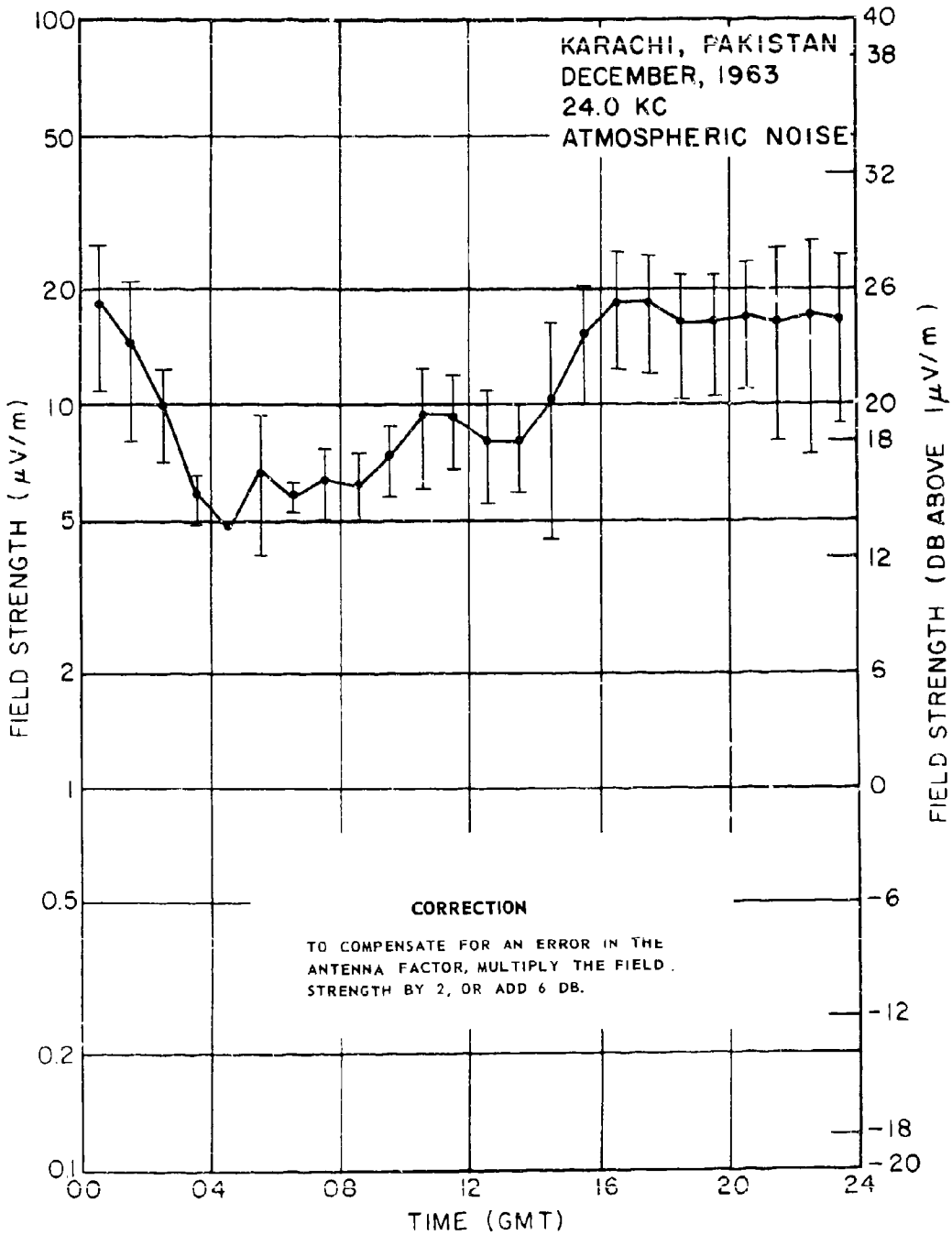
KARACHI, PAKISTAN
DECEMBER, 1963
24.0 KC
ATMOSPHERIC NOISE
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 61

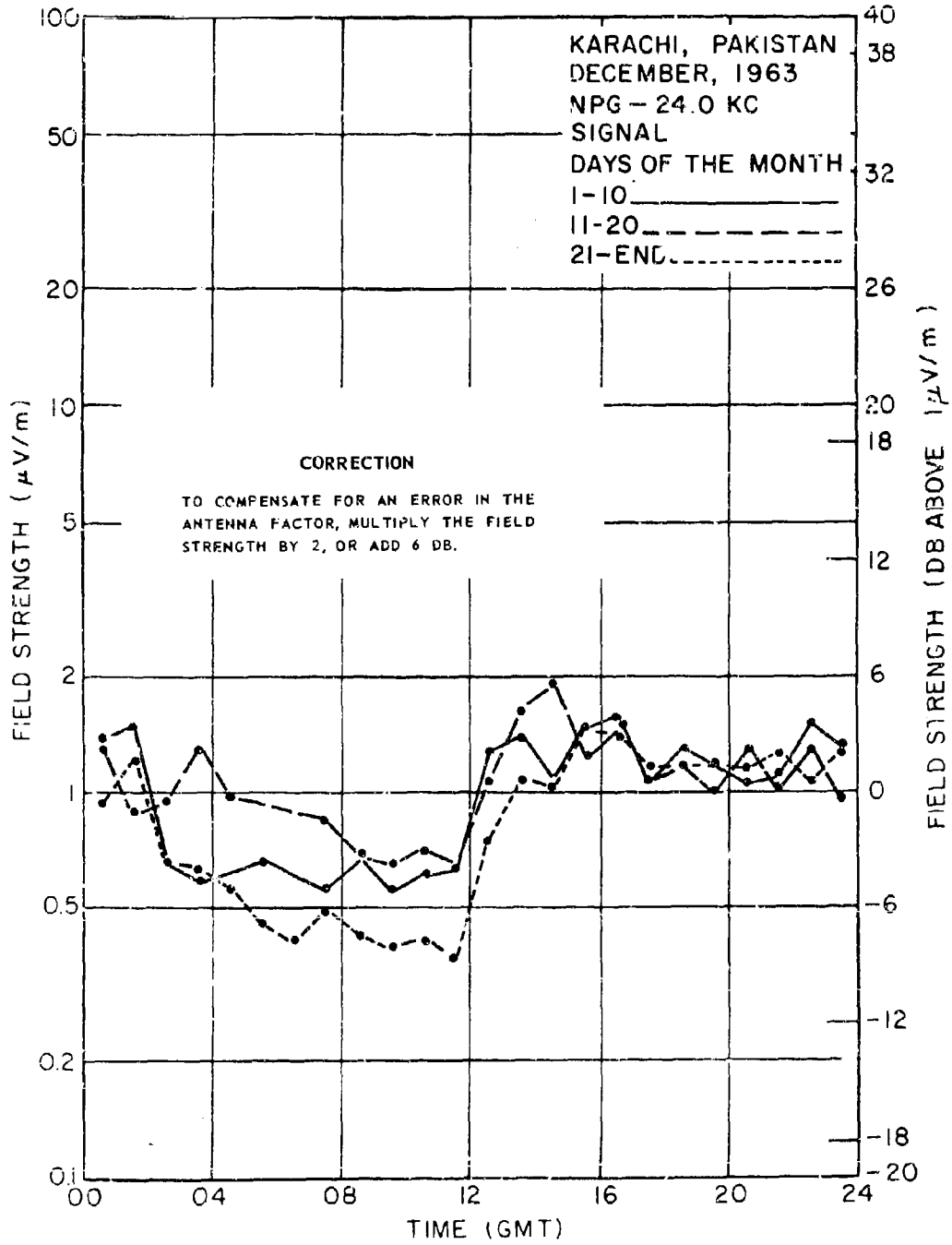
KARACHI, PAKISTAN
DECEMBER, 1963
NPG – 24.0 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 62

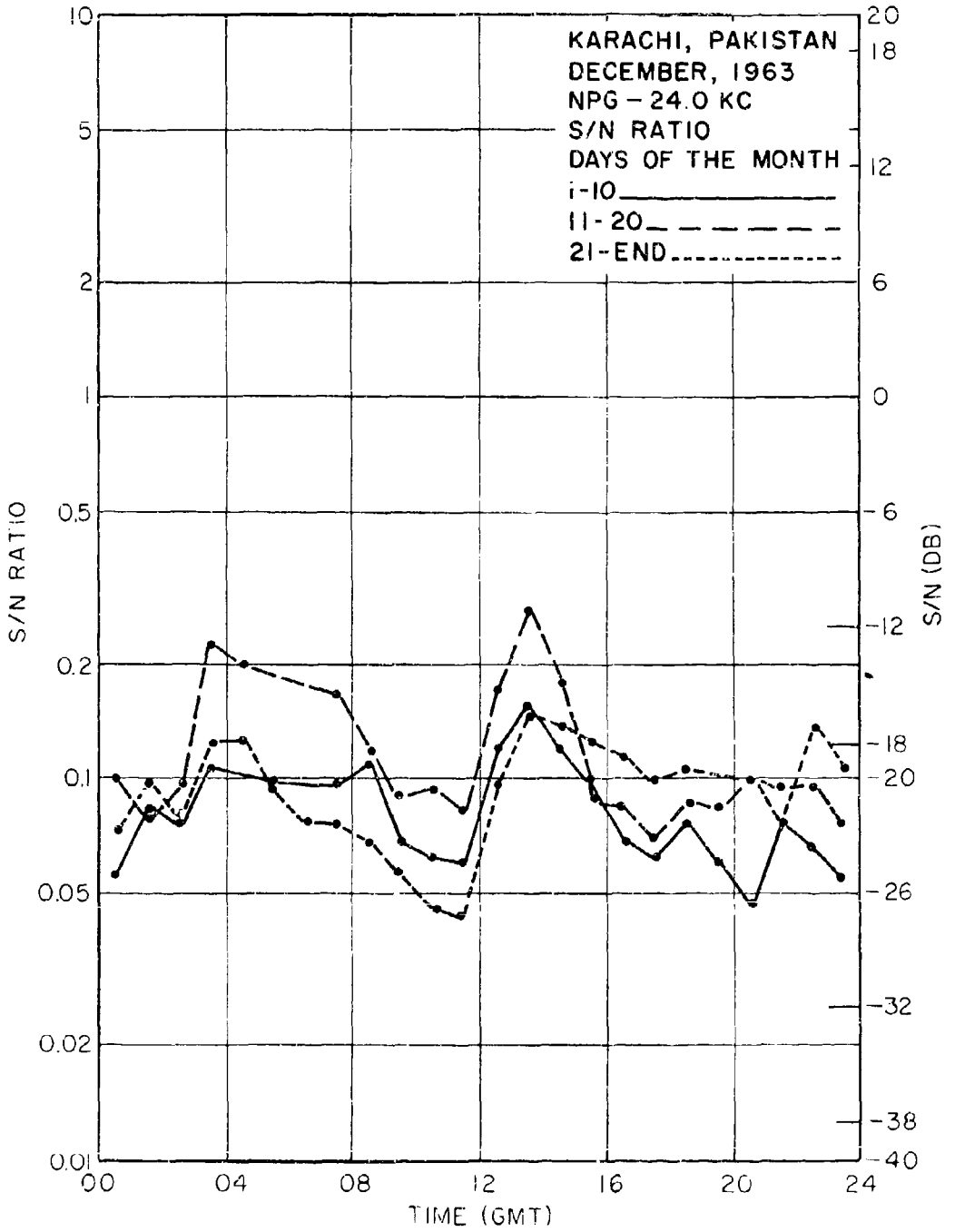
KARACHI, PAKISTAN
DECEMBER, 1963
NPG – 24.0 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 63

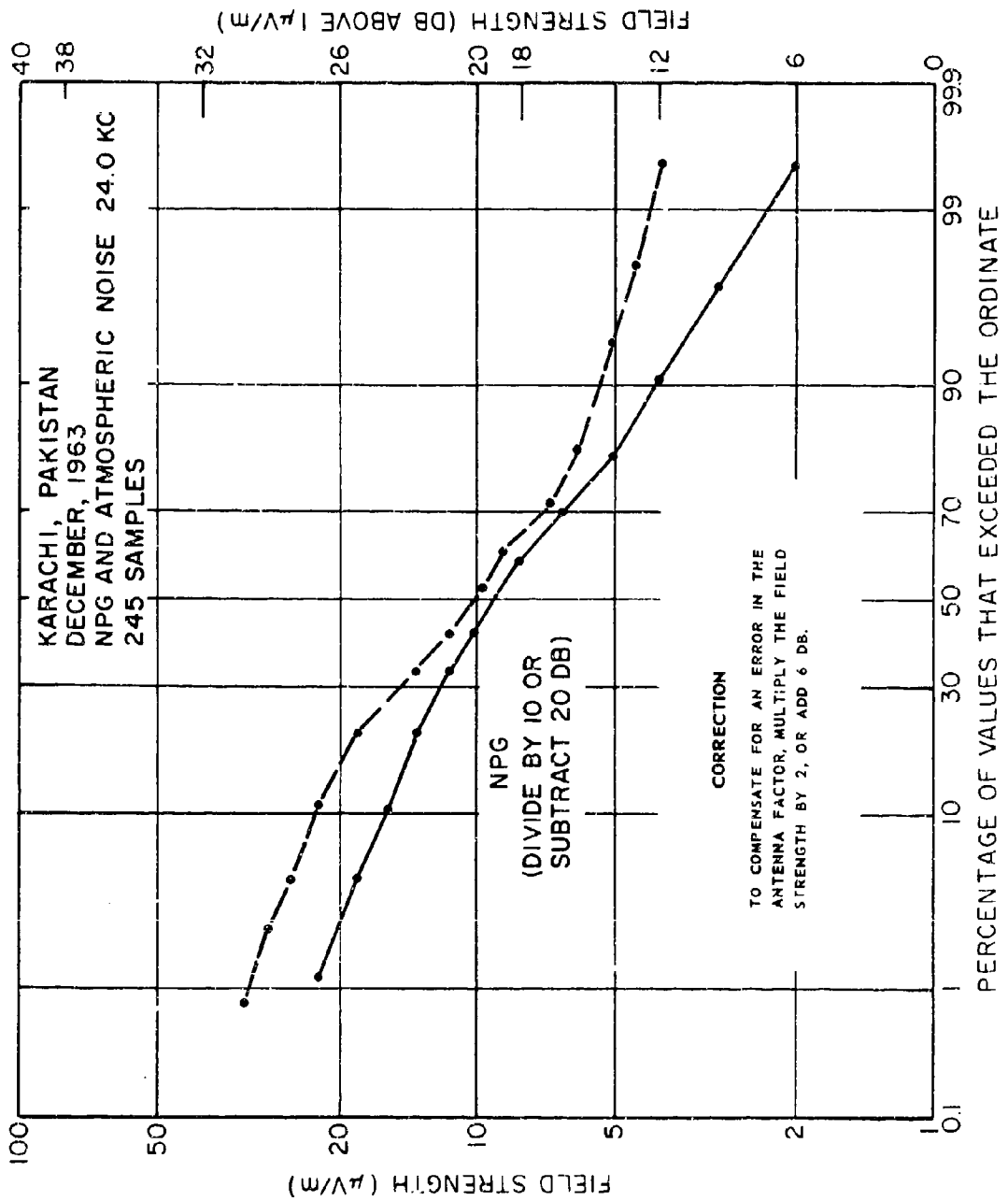
KARACHI, PAKISTAN
DECEMBER, 1963
NPG AND ATMOSPHERIC NOISE 24.0 KC
245 SAMPLES
NPG
(DIVIDE BY 10 OR
SUBTRACT 20 DB)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
99.9
99
90
70
50
30
10
1

Figure 64

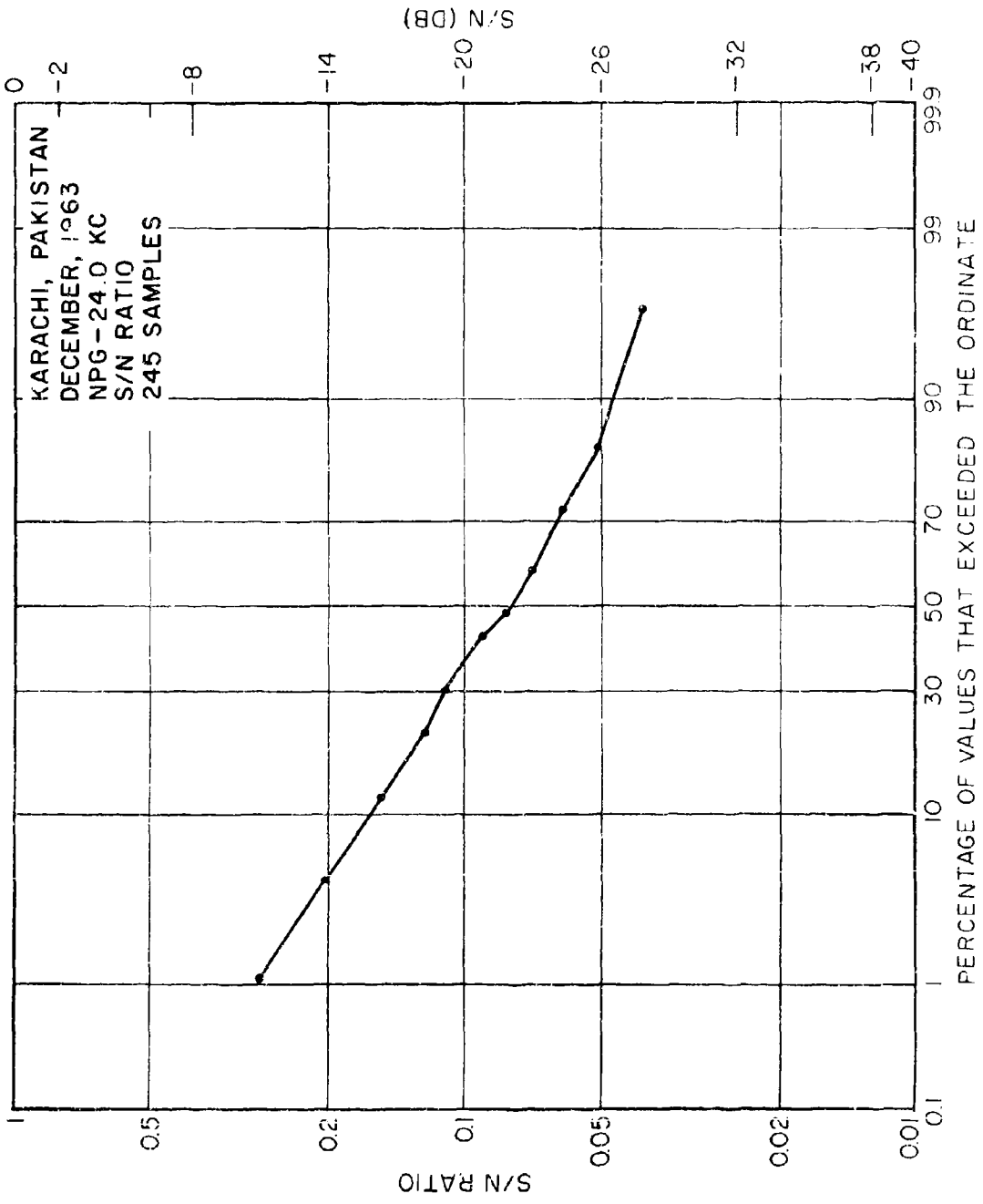
KARACHI, PAKISTAN
DECEMBER, 1963
NPG-24.0 KC
S/N RATIO
245 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 65

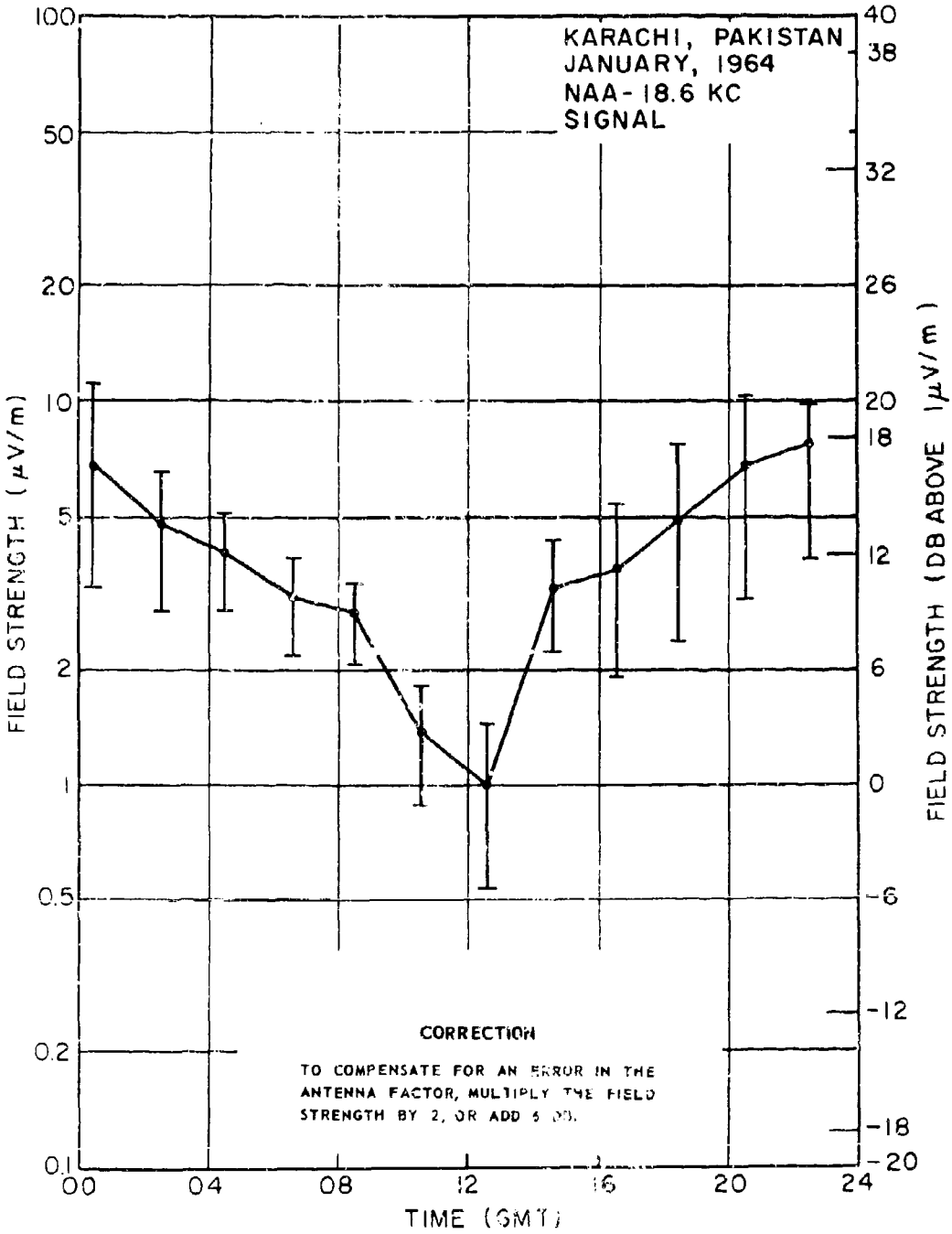
KARACHI, PAKISTAN
JANUARY, 1964
NAA - 18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 66

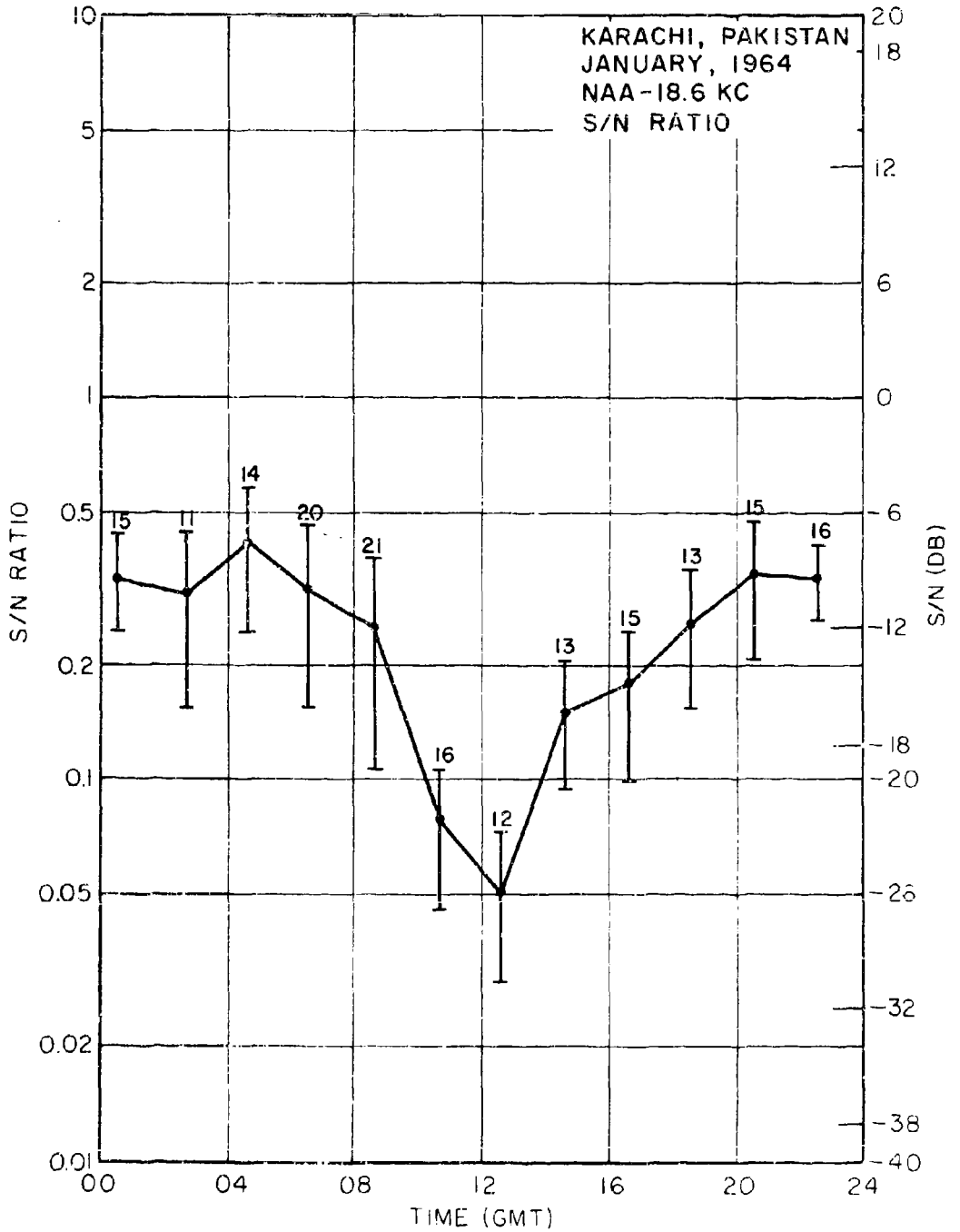
KARACHI, PAKISTAN
JANUARY, 1964
NAA-18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
15
11
14
20
21
16
12
13
15
13
15
16

Figure 67

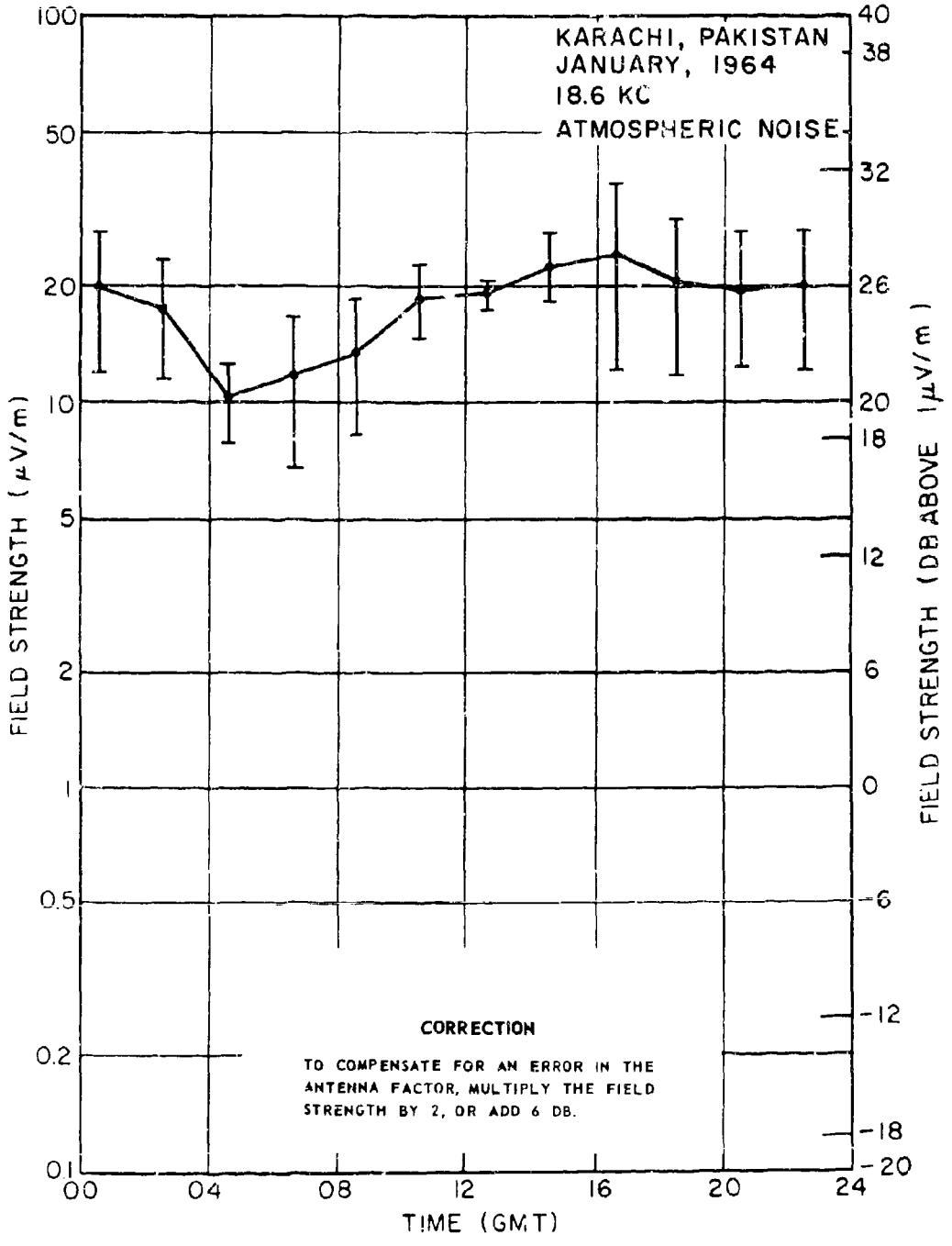
KARACHI, PAKISTAN
JANUARY, 1964
18.6 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 68

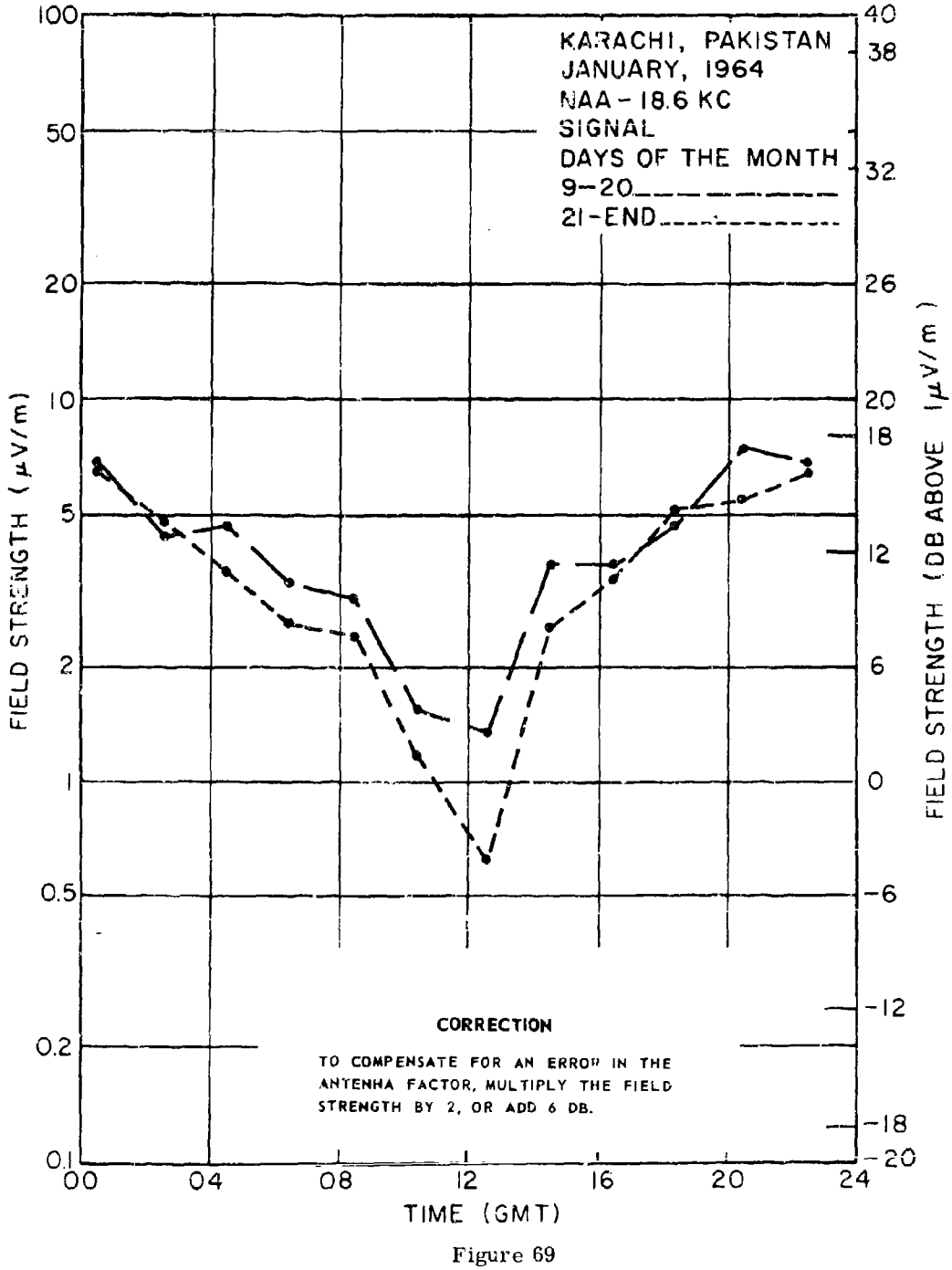
KARACHI, PAKISTAN
JANUARY, 1964
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
9-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 69

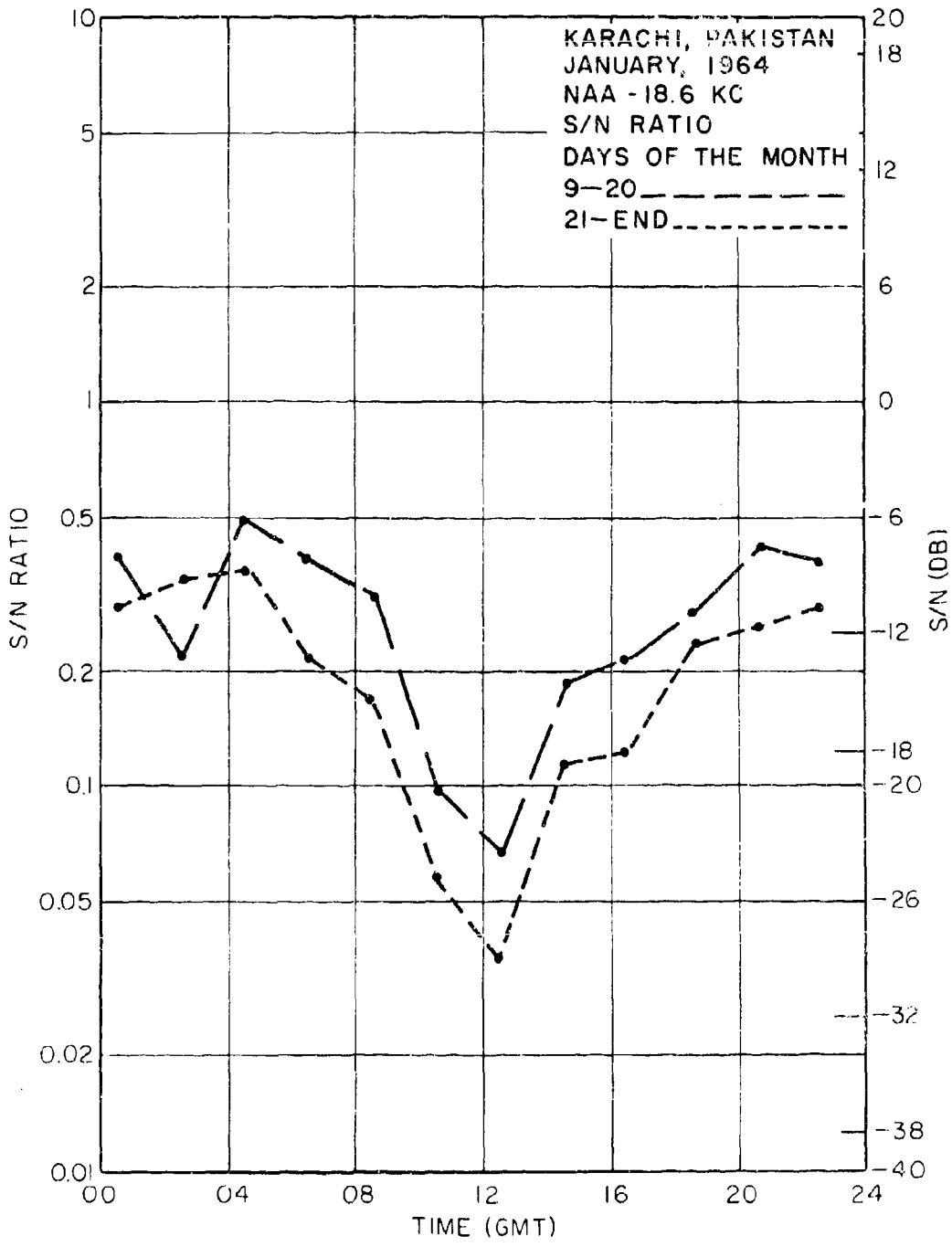
KARACHI, PAKISTAN
JANUARY, 1964
NAA - 18.6 KC
S/N RATIO
DAYS OF THE MONTH
9—20
21—END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 70

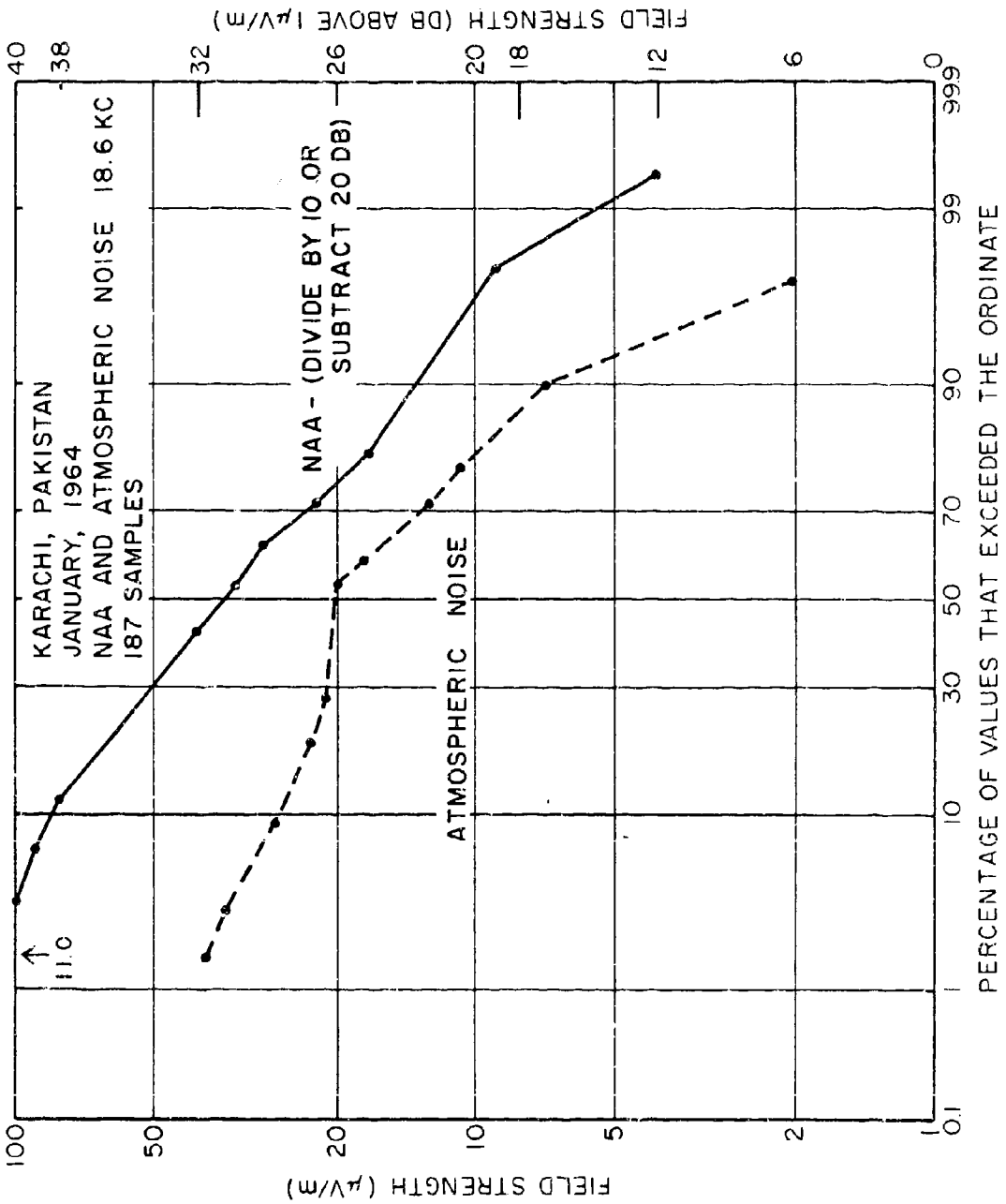
FIELD STRENGTH (DB ABOVE 1 μV/m)
40
38
32
26
20
18
12
6
0
KARACHI, PAKISTAN
JANUARY, 1964
NAA AND ATMOSPHERIC NOISE 18.6 KC
187 SAMPLES
NAA - (DIVIDE BY 10 OR SUBTRACT 20 DB)
ATMOSPHERIC NOISE
11.0
100
50
20
10
5
2
1
0.1
FIELD STRENGTH (μV/m)
99.9
99
90
70
50
30
10
1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE

Figure 71

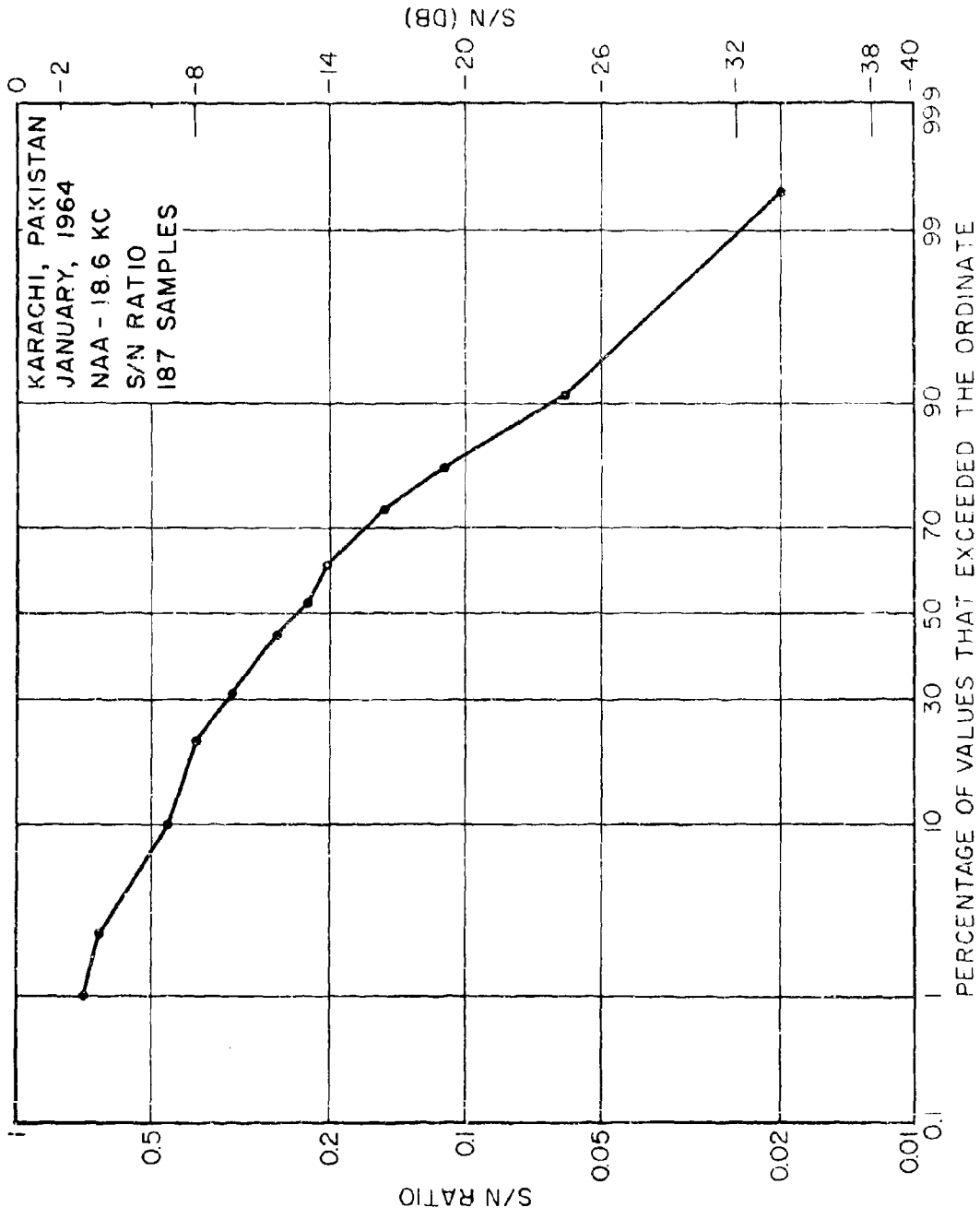
KARACHI, PAKISTAN
JANUARY, 1964
NAA - 18.6 KC
S/N RATIO
187 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
999
99
90
70
50
30
10
1
0.1

Figure 72

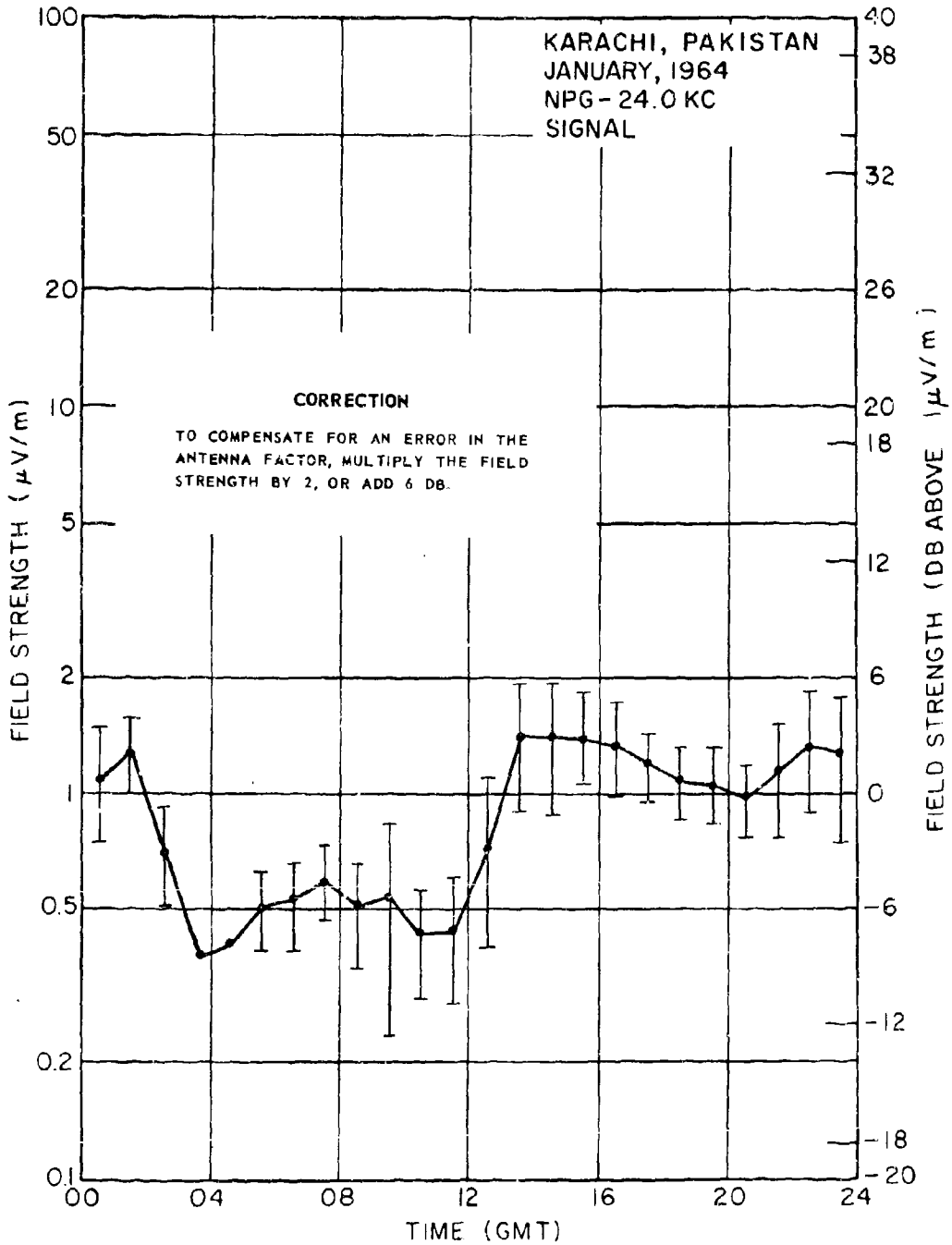
KARACHI, PAKISTAN
JANUARY, 1964
NPG - 24.0 KC
SIGNAL
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 73

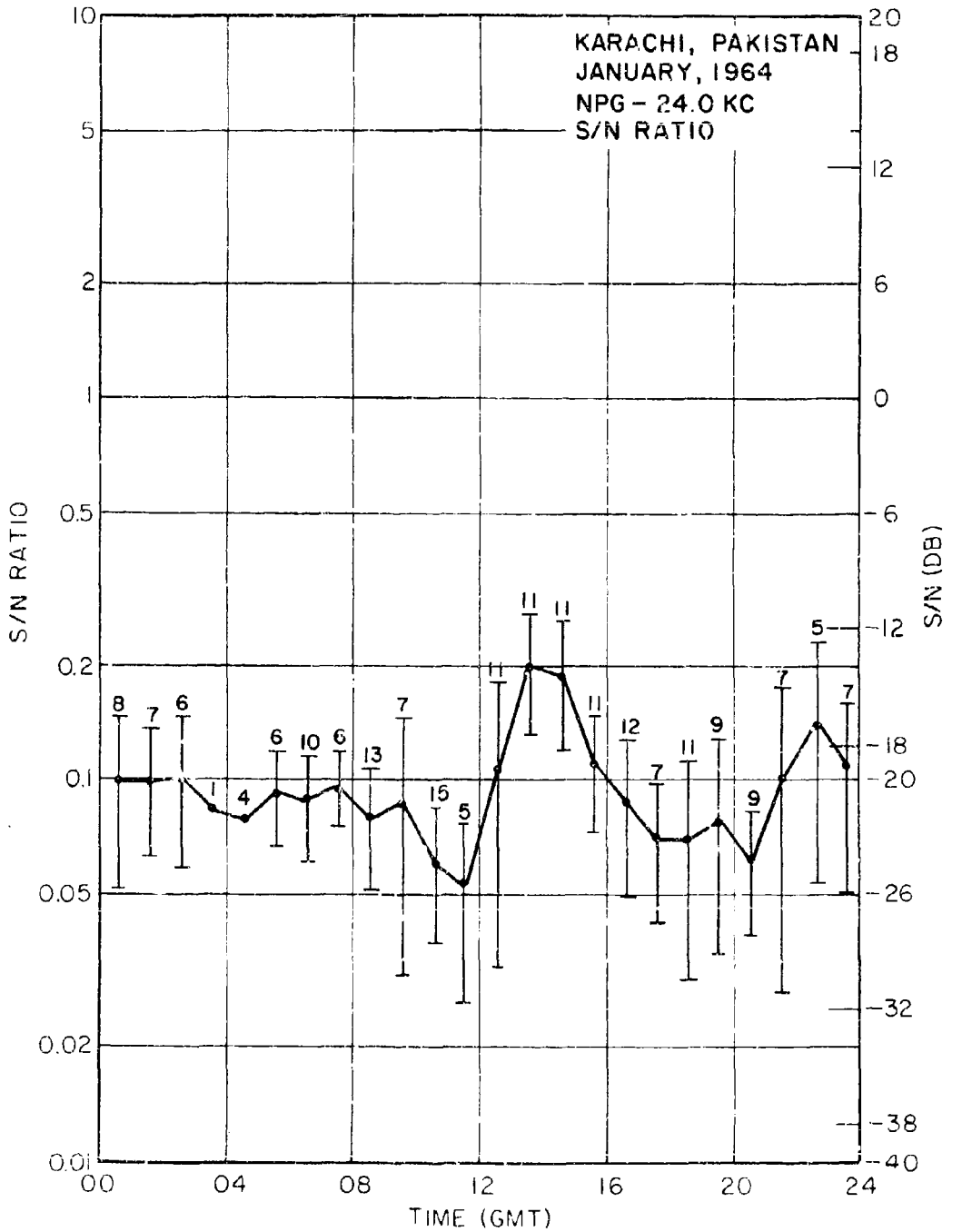
KARACHI, PAKISTAN
JANUARY, 1964
NPG – 24.0 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
8 7 6 1 4 6 10 6 13 7 15 5 11 11 11 11 12 7 11 9 9 7 5 7

Figure 74

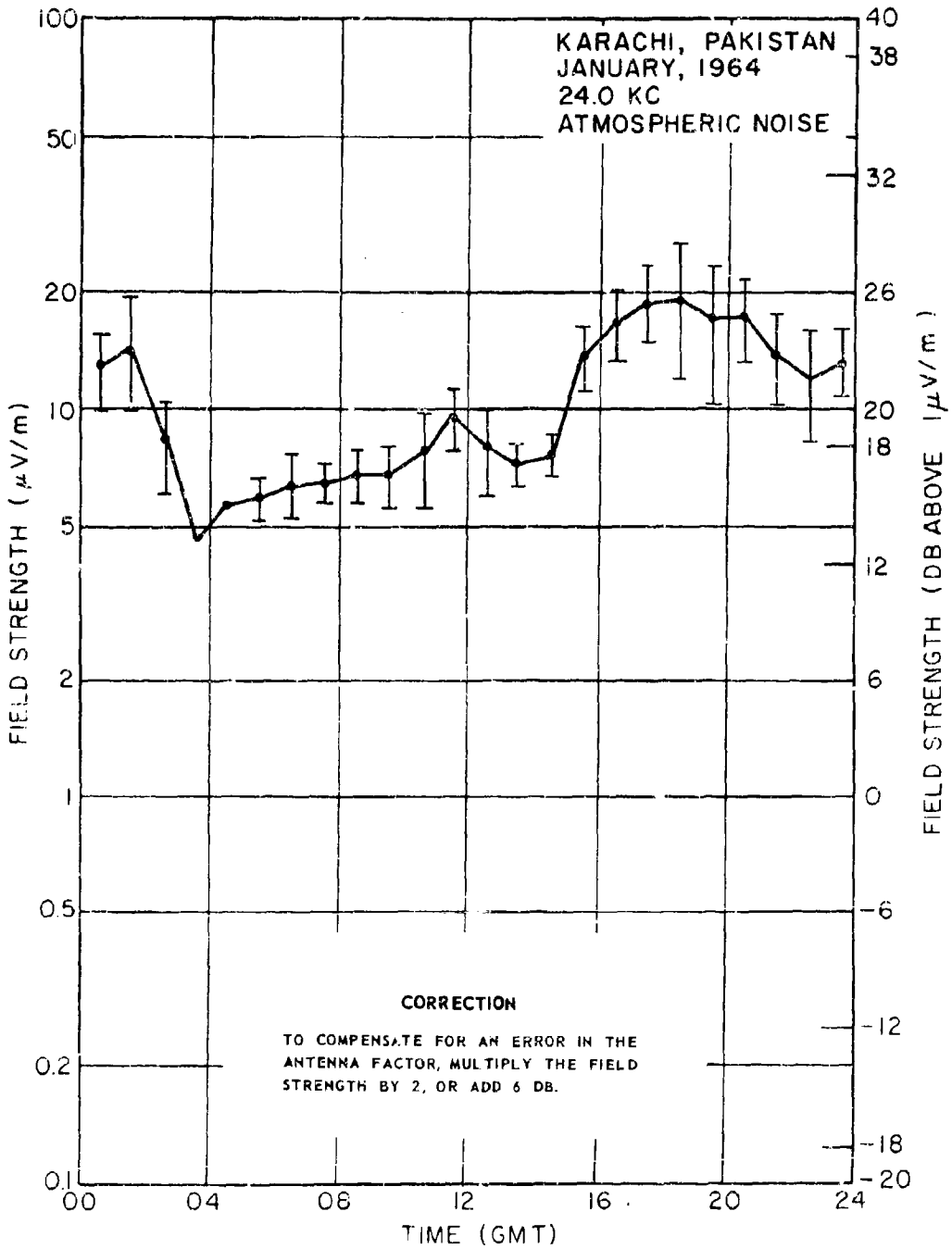
KARACHI, PAKISTAN
JANUARY, 1964
24.0 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 75

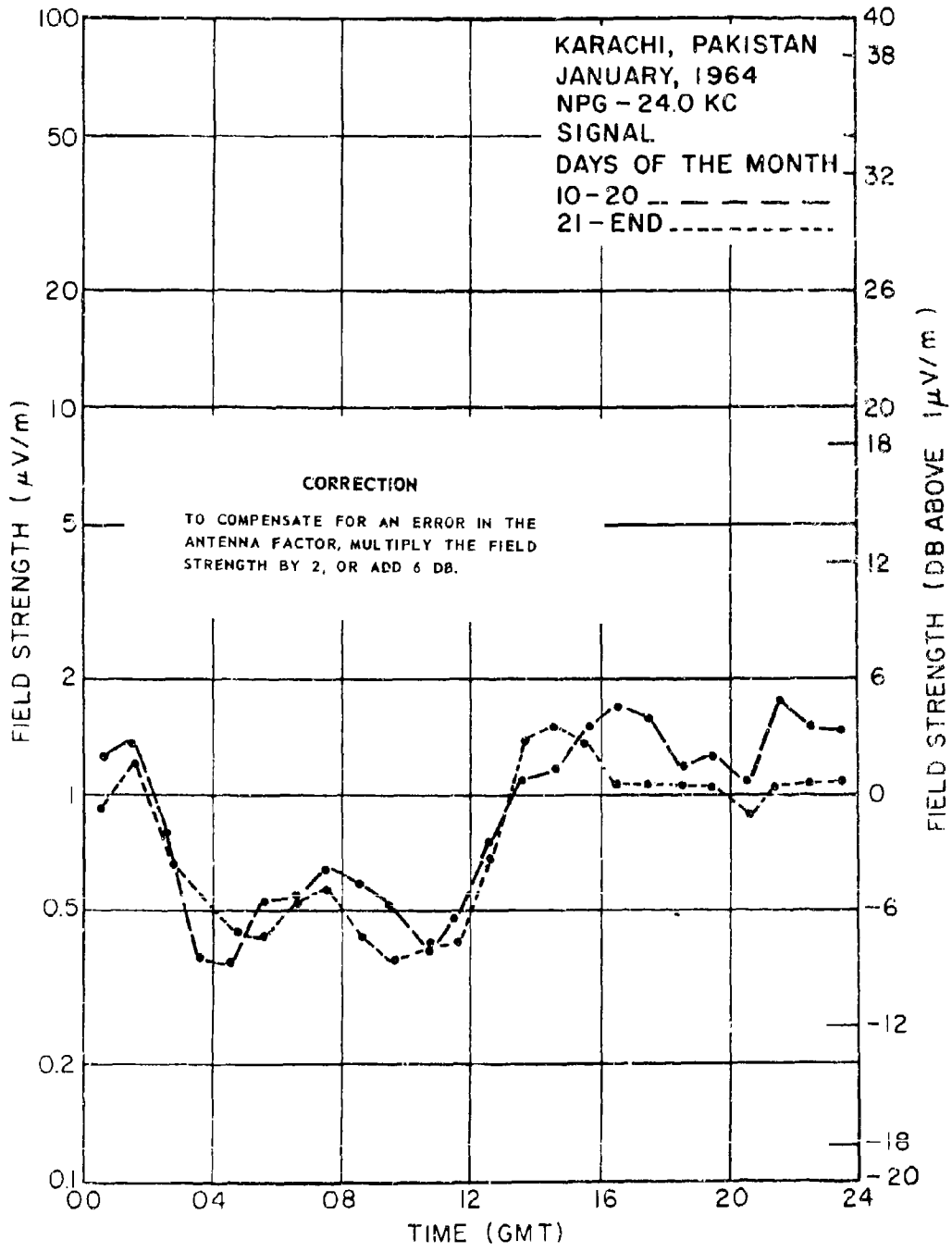
KARACHI, PAKISTAN
JANUARY, 1964
NPG – 24.0 KC
SIGNAL
DAYS OF THE MONTH
10 – 20
21 – END
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24

Figure 76

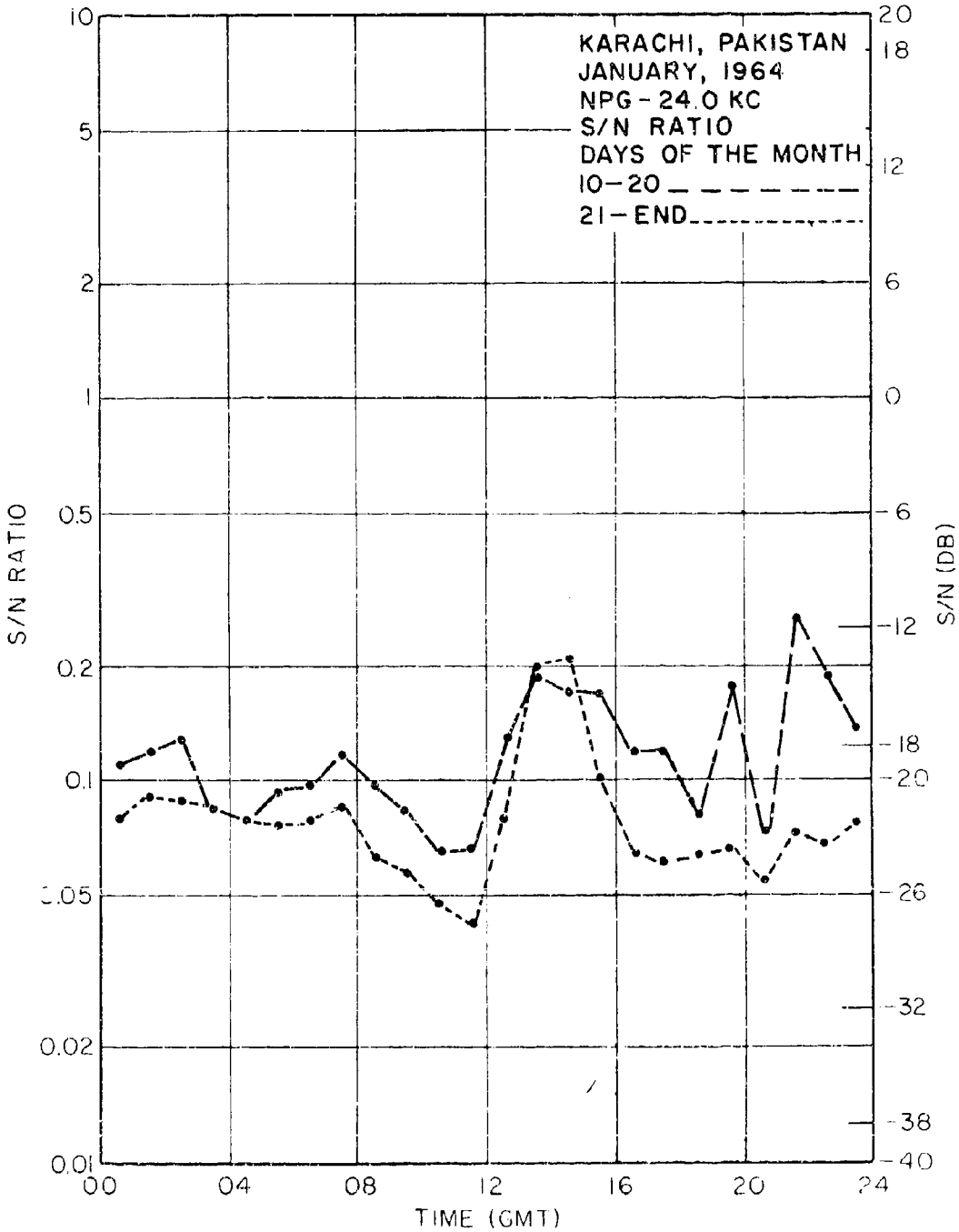
KARACHI, PAKISTAN
JANUARY, 1964
NPG - 24.0 KC
S/N RATIO
DAYS OF THE MONTH
10-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 77

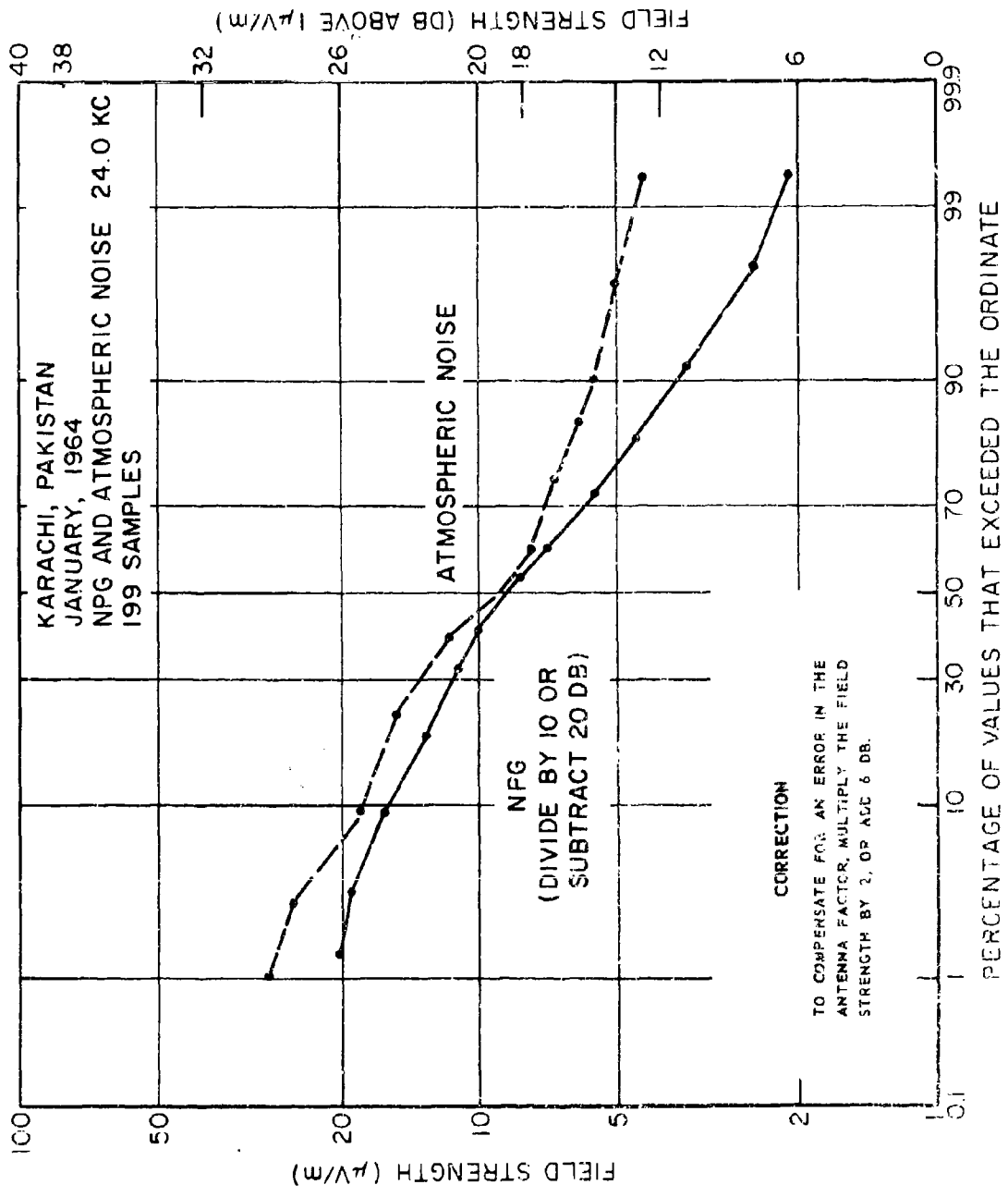
KARACHI, PAKISTAN
JANUARY, 1964
NPG AND ATMOSPHERIC NOISE 24.0 KC
199 SAMPLES
ATMOSPHERIC NOISE
NFG
(DIVIDE BY 10 OR
SUBTRACT 20 DB)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE
ANTENNA FACTOR, MULTIPLY THE FIELD
STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
99.9
99
90
70
50
30
10
1

Figure 78

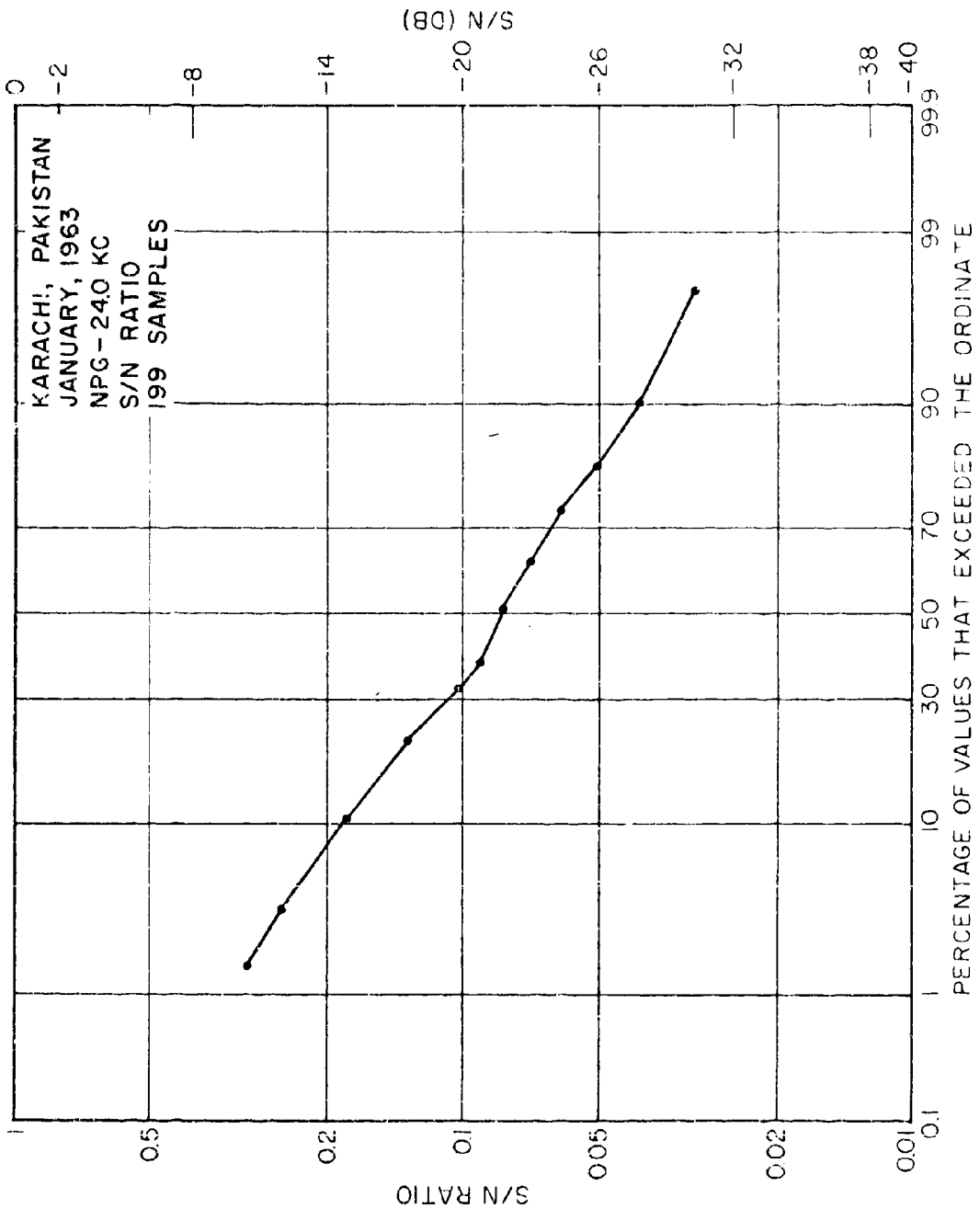
KARACHI, PAKISTAN
JANUARY, 1963
NPG-24.0 KC
S/N RATIO
199 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 79

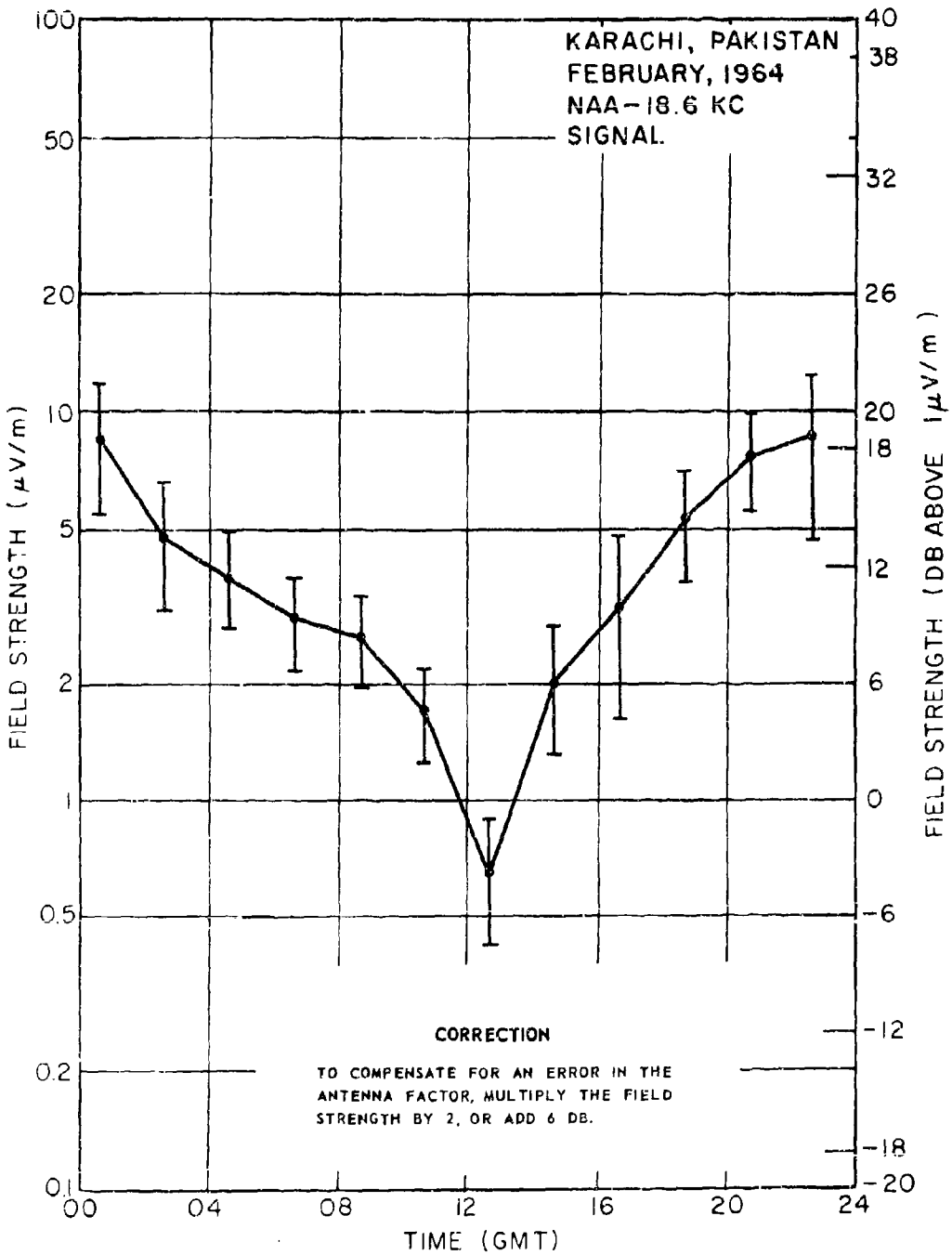
KARACHI, PAKISTAN
FEBRUARY, 1964
NAA-18.6 KC
SIGNAL.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 80

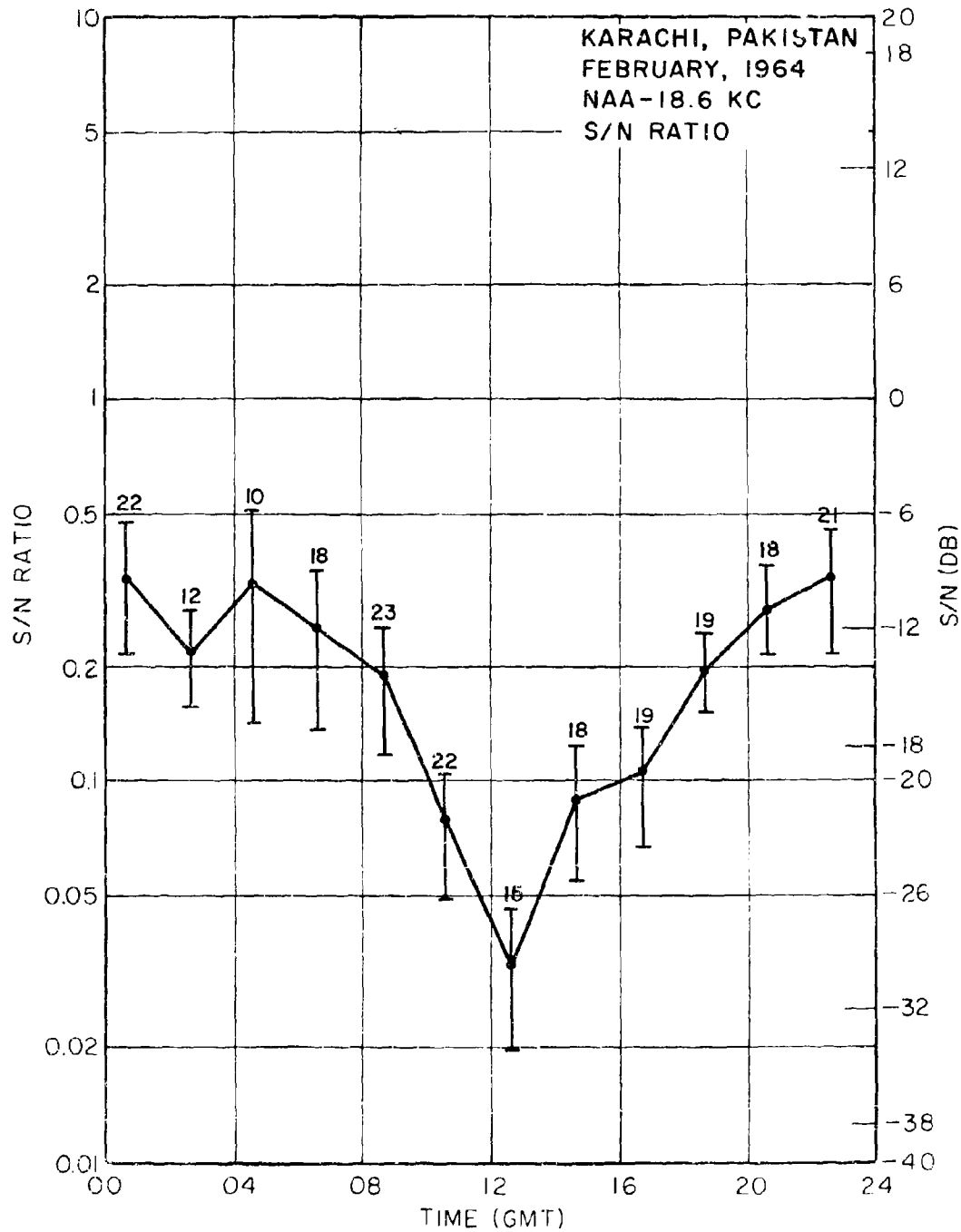
KARACHI, PAKISTAN
FEBRUARY, 1964
NAA-18.6 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
22
12
10
18
23
22
15
18
19
19
18
21

Figure 81

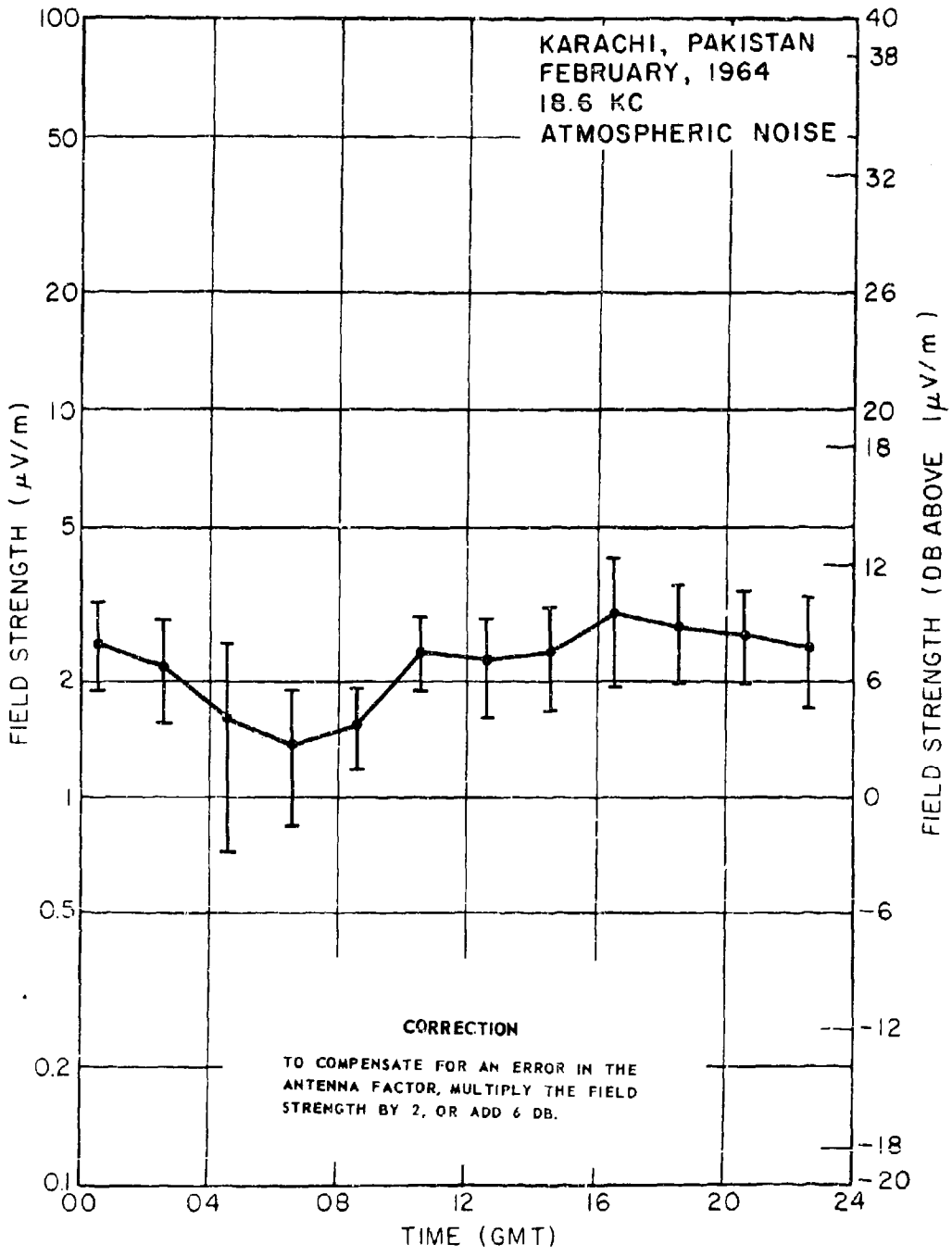
KARACHI, PAKISTAN
FEBRUARY, 1964
18.6 KC
ATMOSPHERIC NOISE
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 82

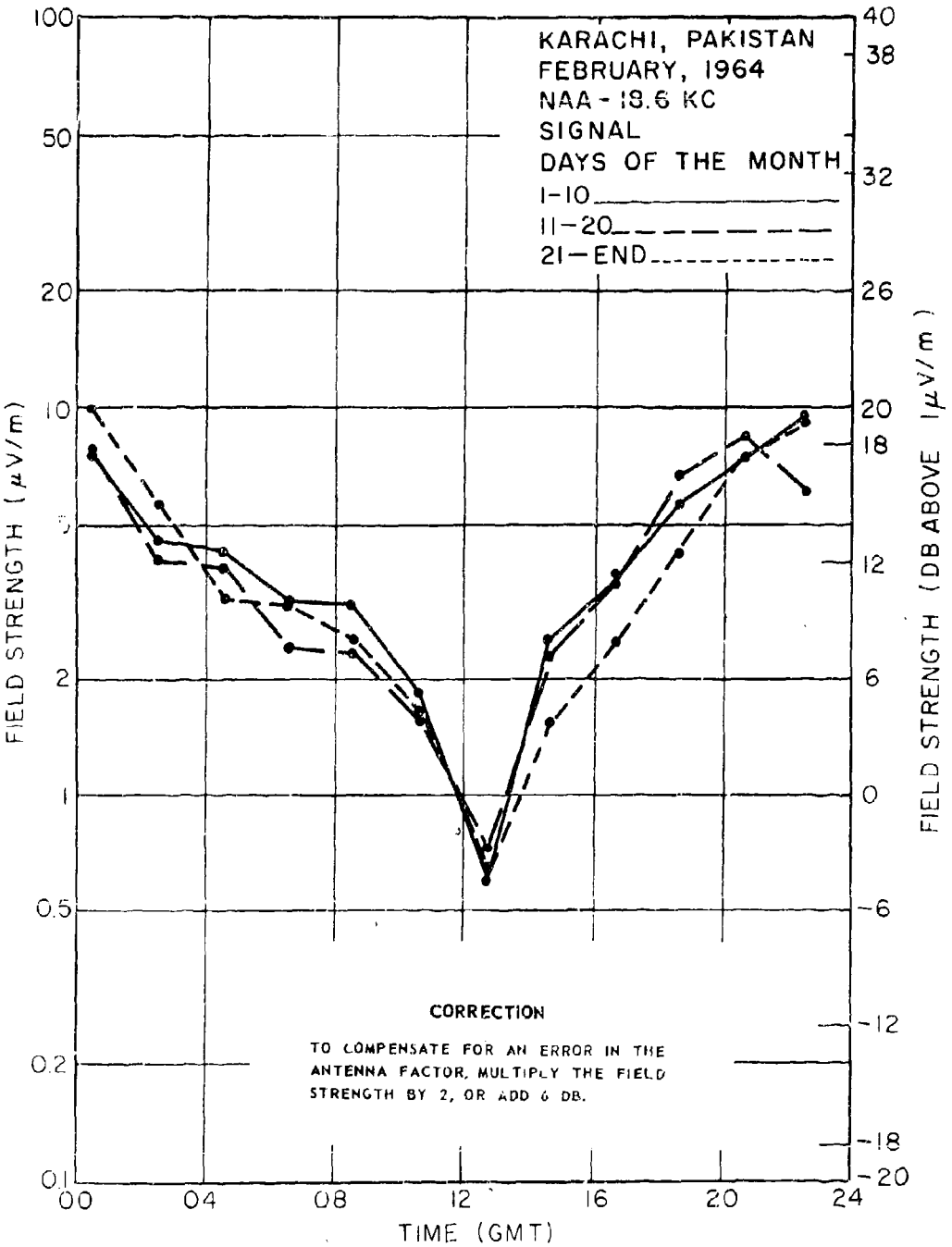
KARACHI, PAKISTAN
FEBRUARY, 1964
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 83

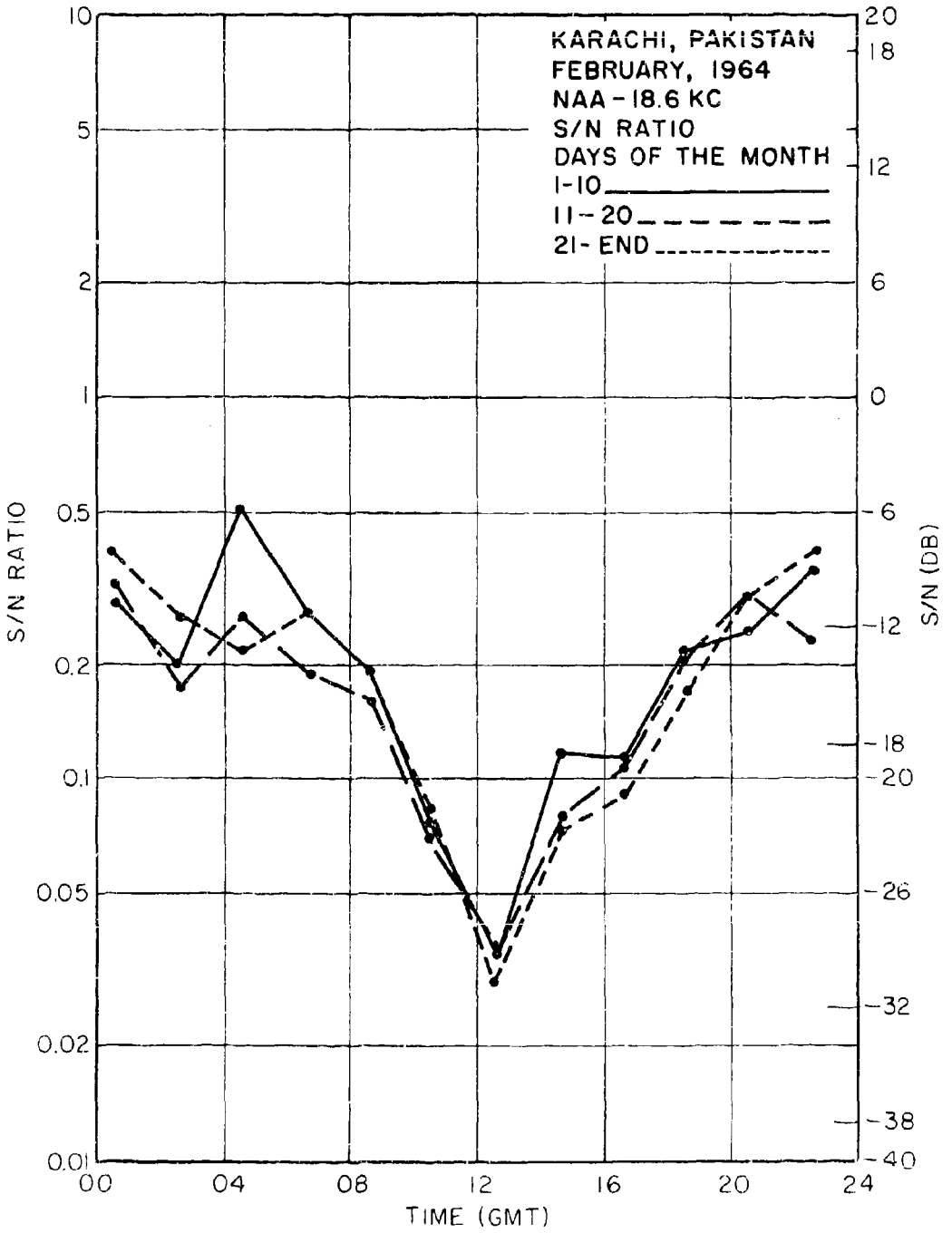
KARACHI, PAKISTAN
FEBRUARY, 1964
NAA - 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 84

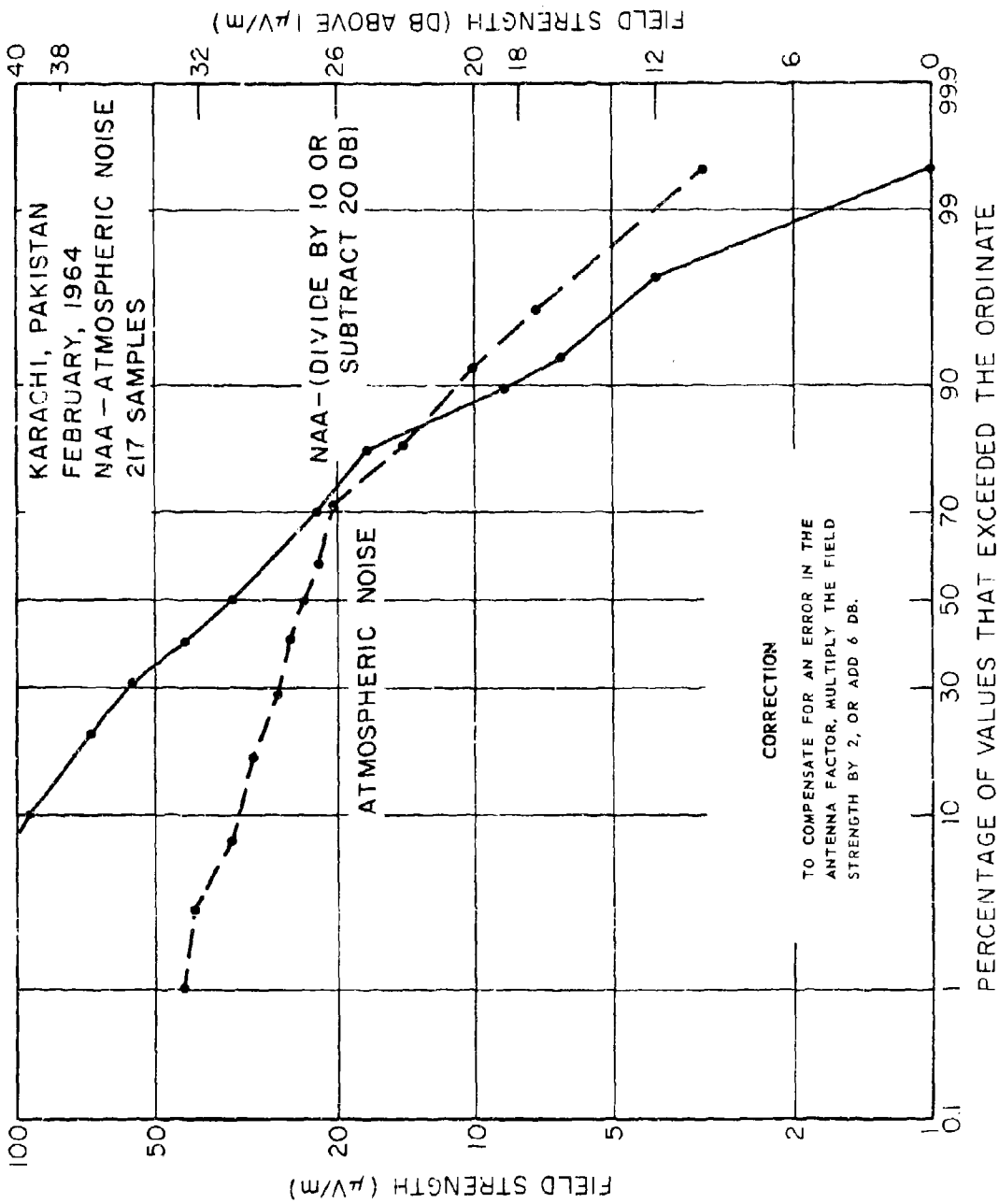
FIELD STRENGTH (DB ABOVE 1 μV/m)
40
38
32
26
20
18
12
6
0
KARACHI, PAKISTAN
FEBRUARY, 1964
NAA – ATMOSPHERIC NOISE
217 SAMPLES
NAA – (DIVIDE BY 10 OR SUBTRACT 20 DB)
ATMOSPHERIC NOISE
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
999
99
90
70
50
30
10
1
0.1
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
FIELD STRENGTH (μV/m)

Figure 85

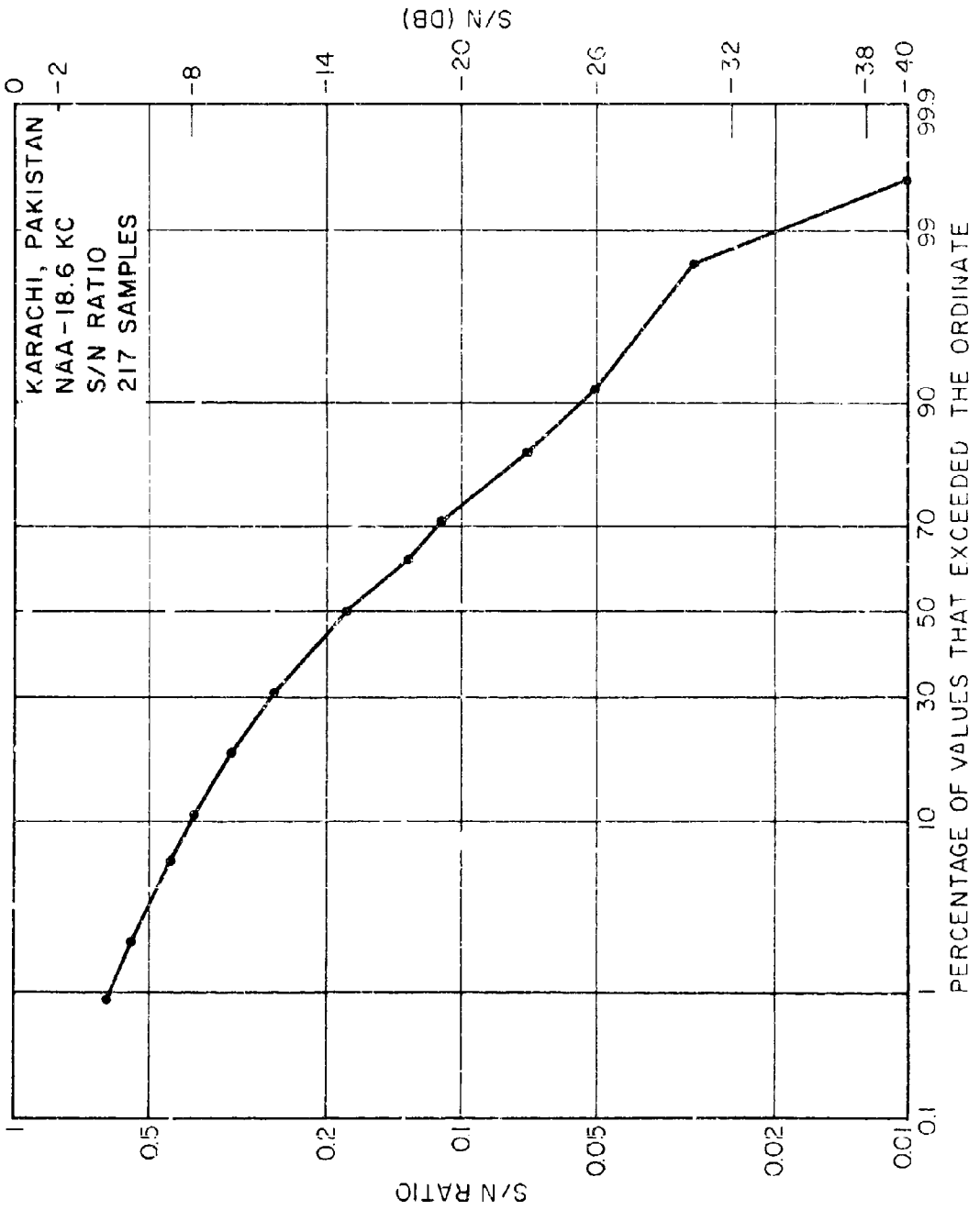
KARACHI, PAKISTAN
NAA-18.6 KC
S/N RATIO
217 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 86

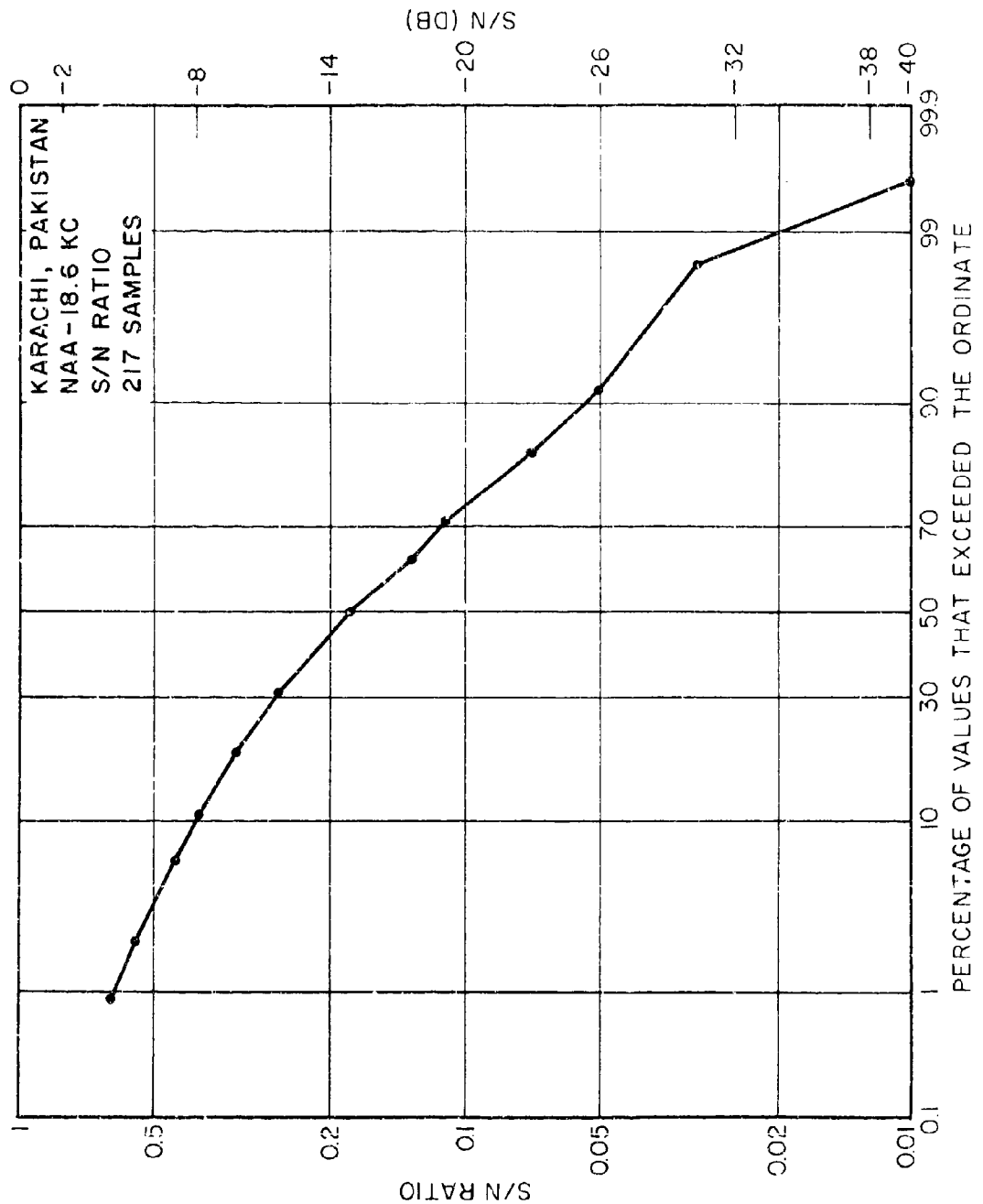
KARACHI, PAKISTAN
NAA-18.6 KC
S/N RATIO
217 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 86

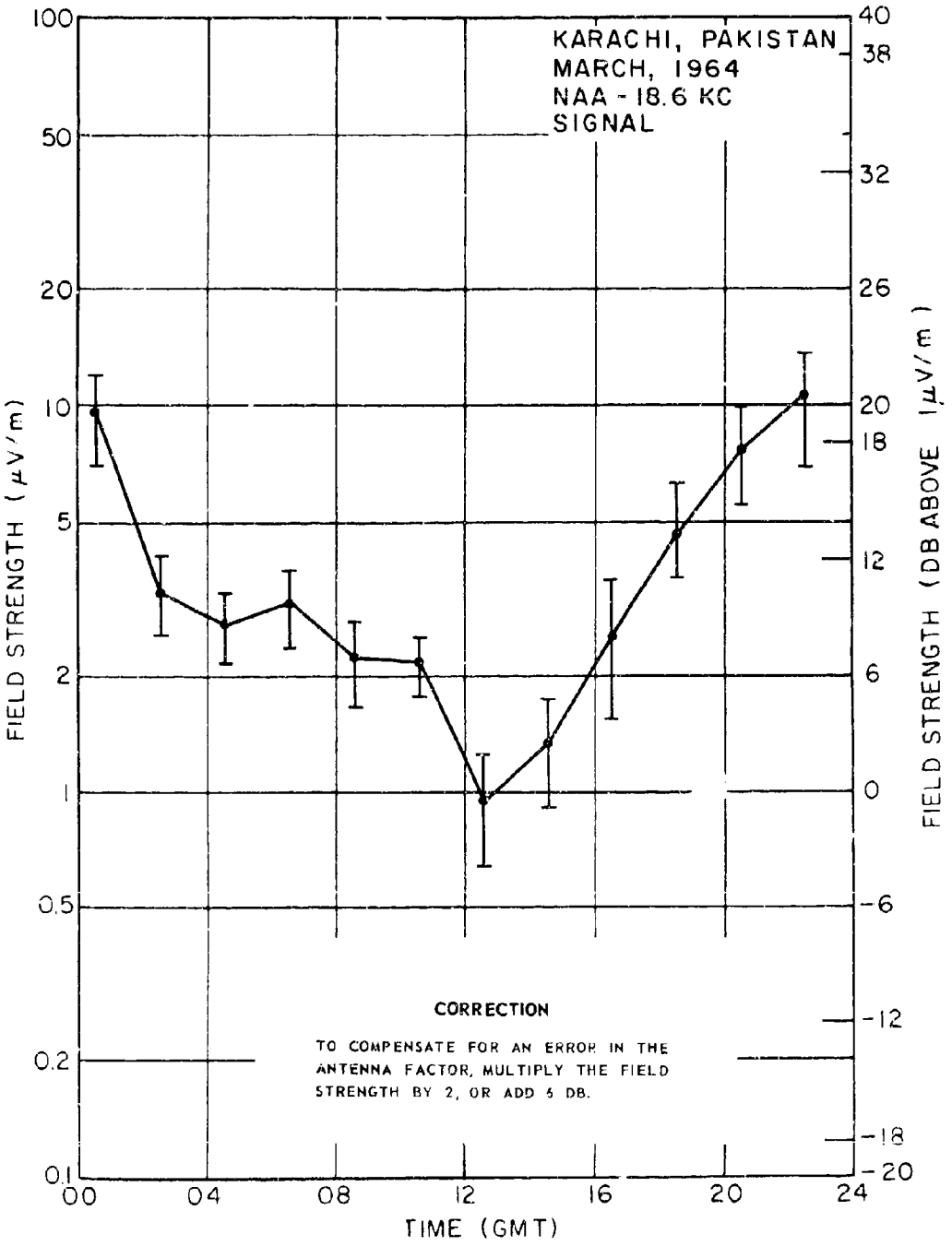
KARACHI, PAKISTAN
MARCH, 1964
NAA - 18.6 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 87

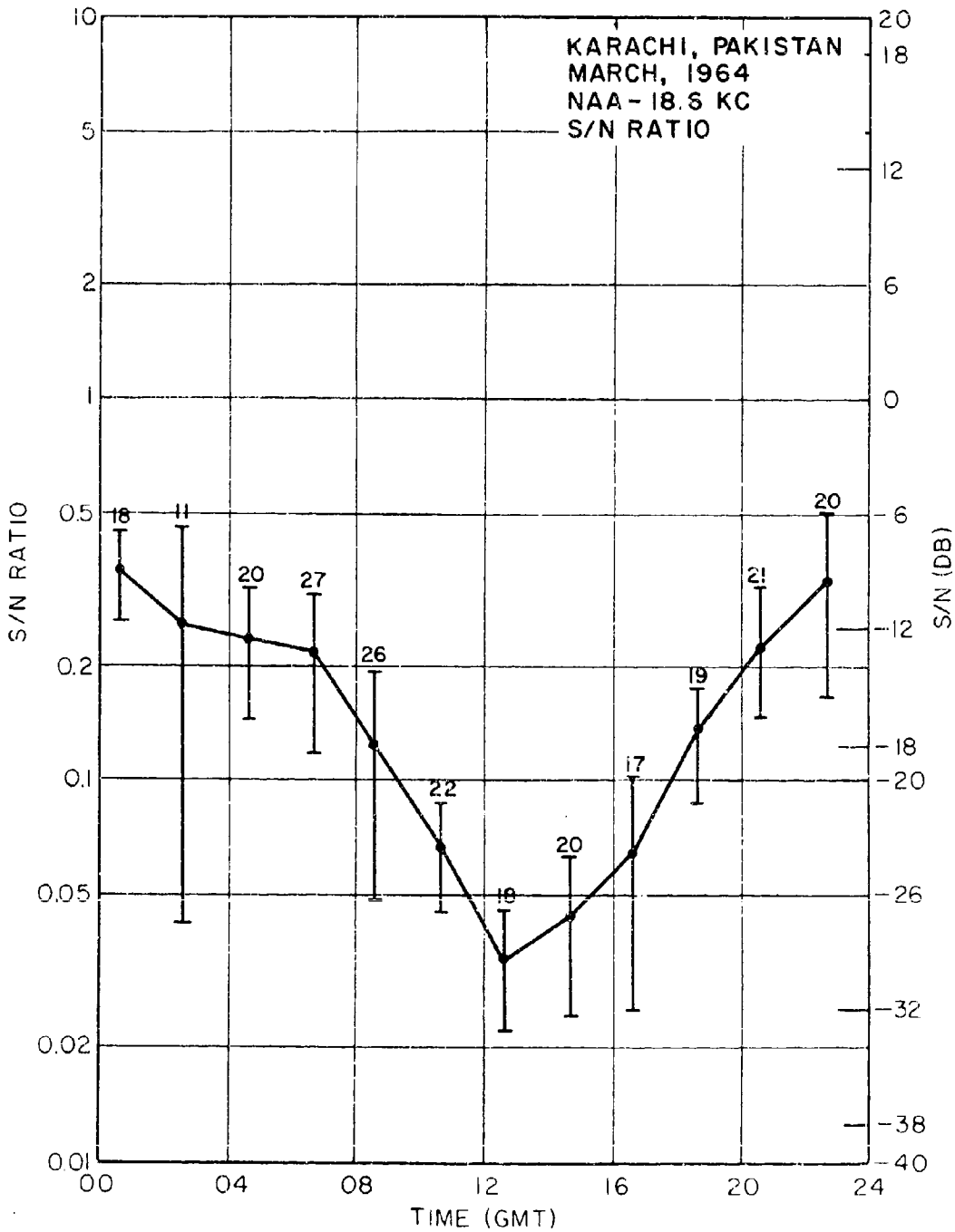
KARACHI, PAKISTAN
MARCH, 1964
NAA - 18.5 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
18
11
20
27
26
22
16
20
17
19
21
20

Figure 88

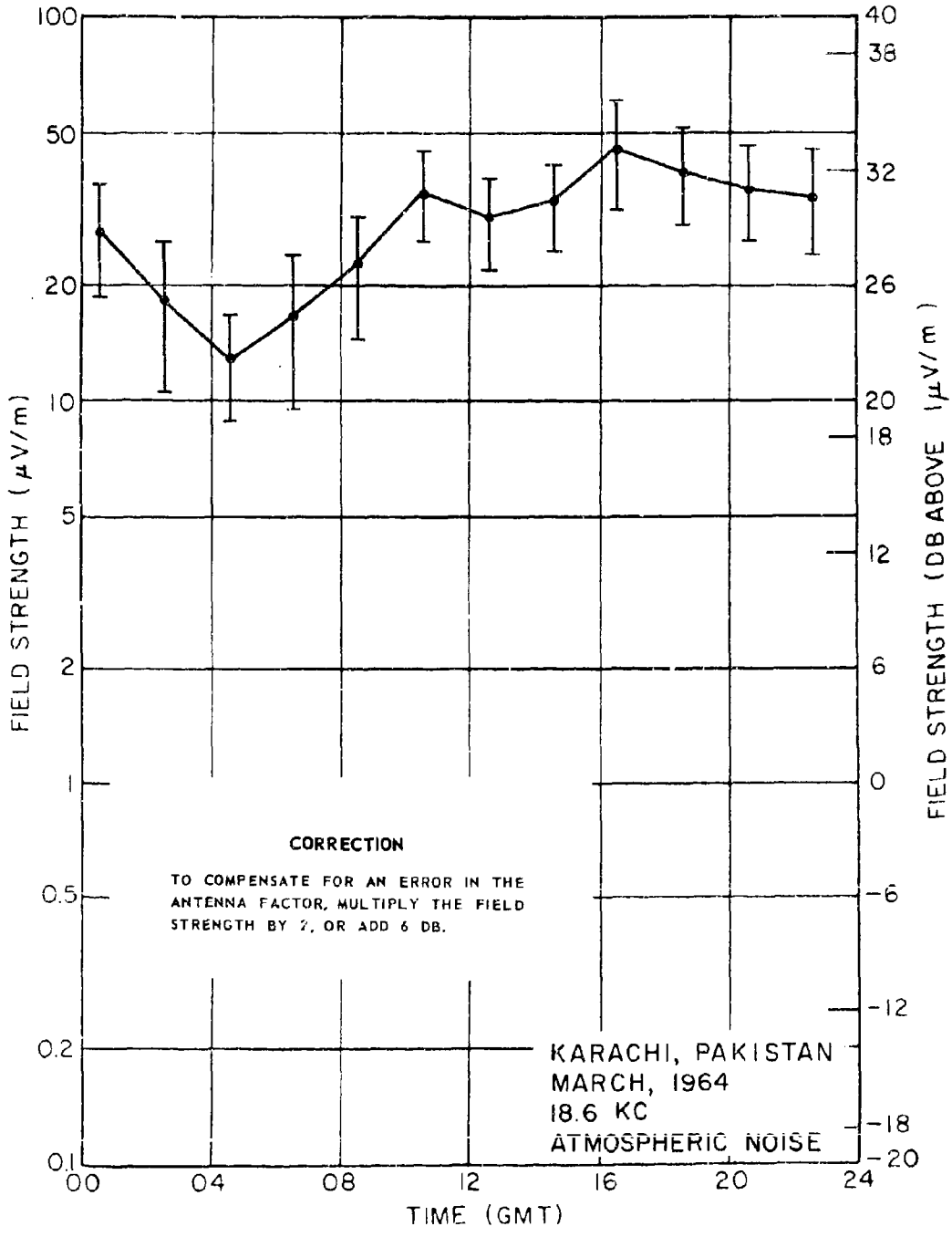
100
50
20
10
5
2
1
0.5
0.2
0.1
FIELD STRENGTH (μV/m)
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
FIELD STRENGTH (DB ABOVE 1μV/m)
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
MARCH, 1964
18.6 KC
ATMOSPHERIC NOISE

Figure 89

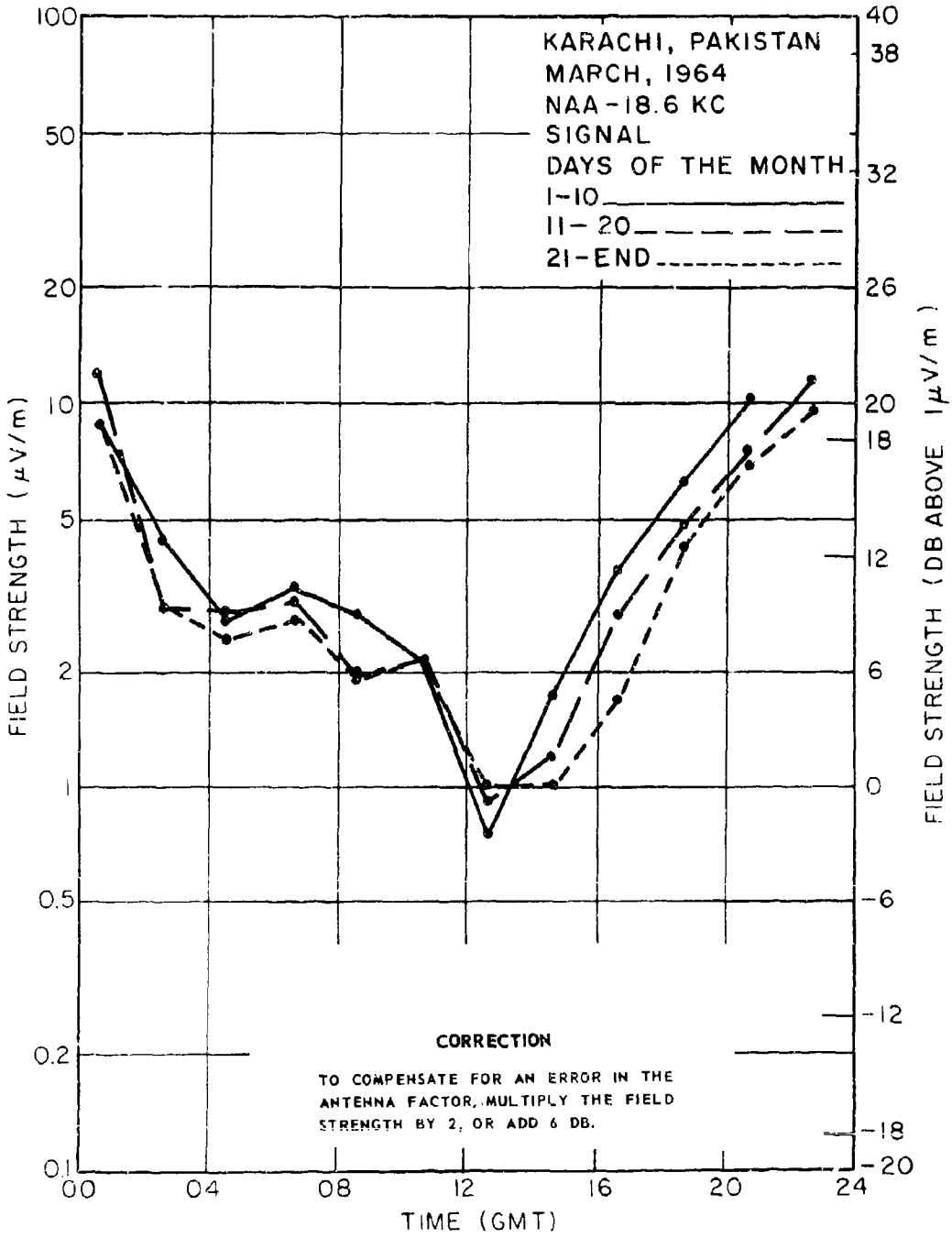
KARACHI, PAKISTAN
MARCH, 1964
NAA - 18.6 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 90

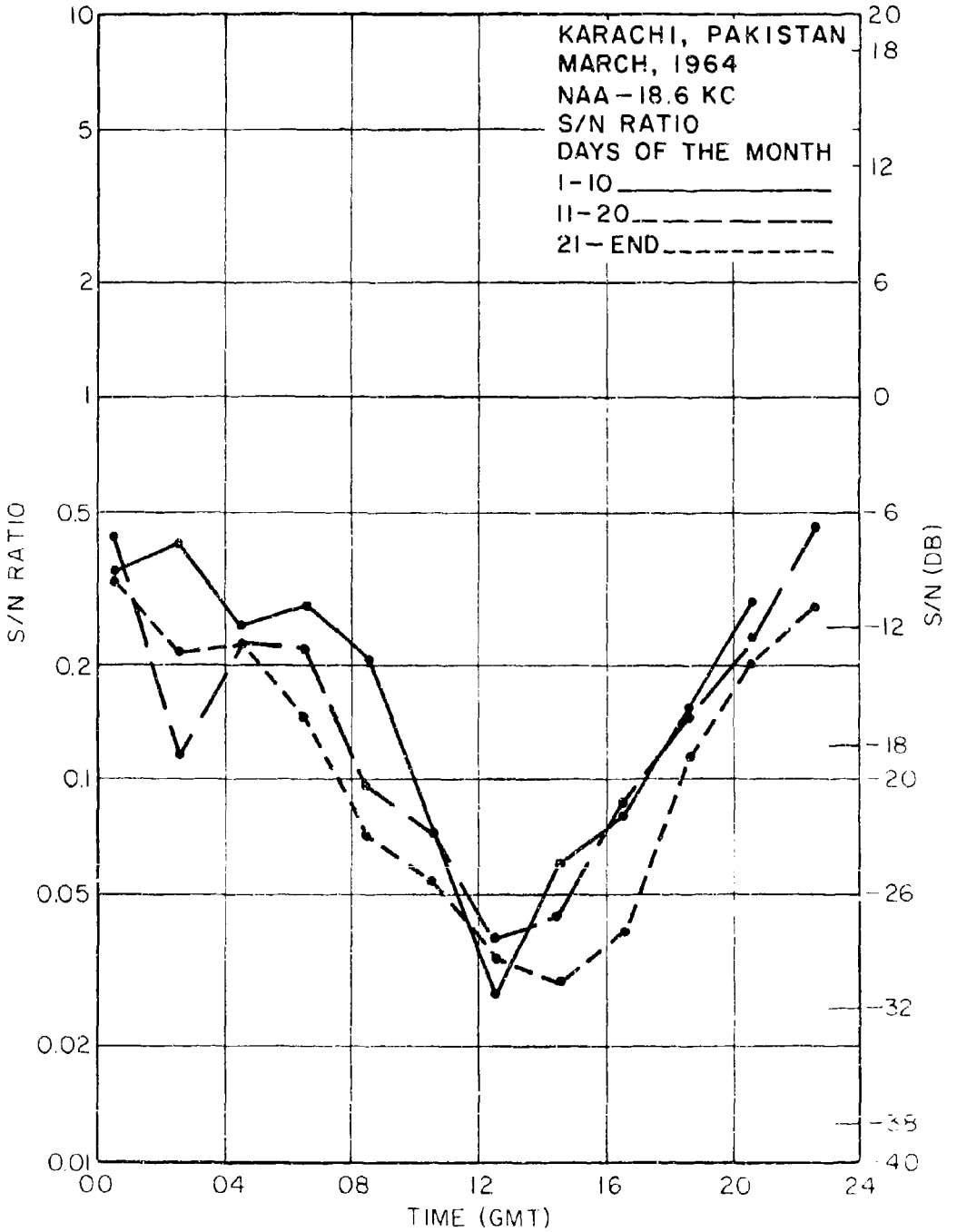
KARACHI, PAKISTAN
MARCH, 1964
NAA – 18.6 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-35
-40
00
04
08
12
16
20
24

Figure 91

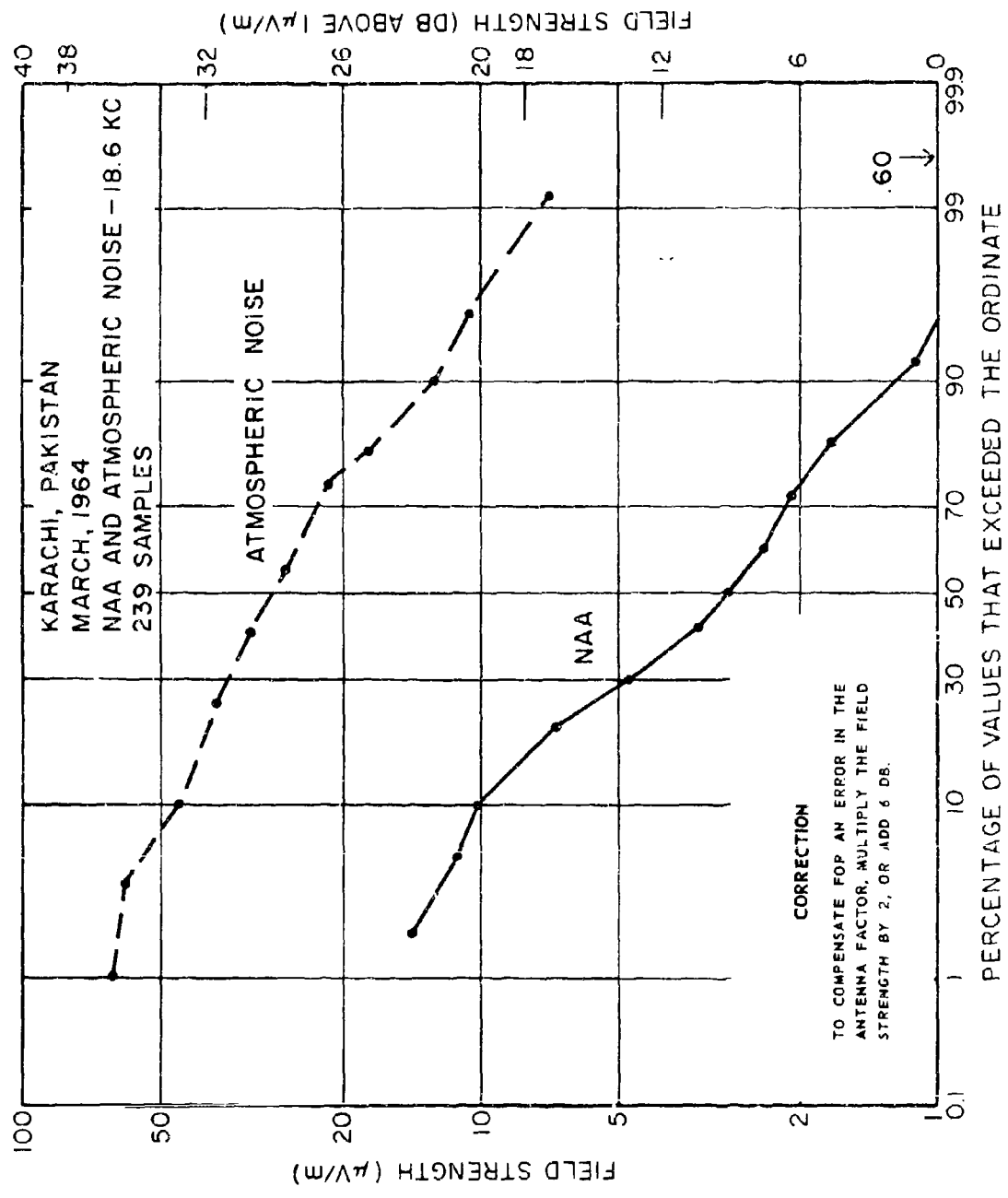
KARACHI, PAKISTAN
MARCH, 1964
NAA AND ATMOSPHERIC NOISE – 18.6 KC
239 SAMPLES
ATMOSPHERIC NOISE
NAA
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1 μV/m)
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
100
50
20
10
5
2
1
0.1
40
38
32
26
20
18
12
6
0
99.9
99
90
70
50
30
10
1
.60

Figure 92

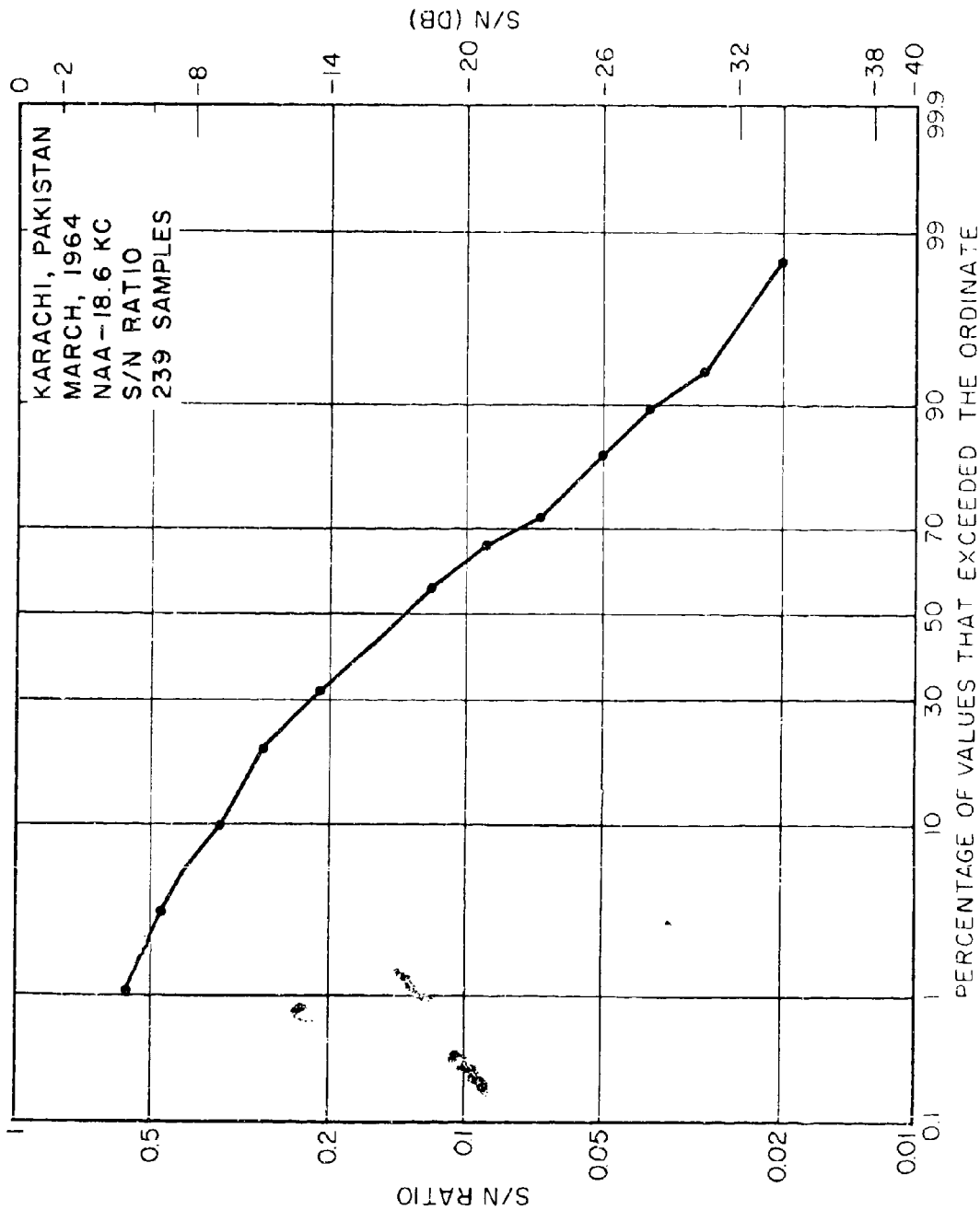
KARACHI, PAKISTAN
MARCH, 1964
NAA-18.6 KC
S/N RATIO
239 SAMPLES
S/N (DB)
0
-2
-8
-14
-20
-26
-32
-38
-40
S/N RATIO
1
0.5
0.2
0.1
0.05
0.02
0.01
PERCENTAGE OF VALUES THAT EXCEEDED THE ORDINATE
99.9
99
90
70
50
30
10
1
0.1

Figure 93

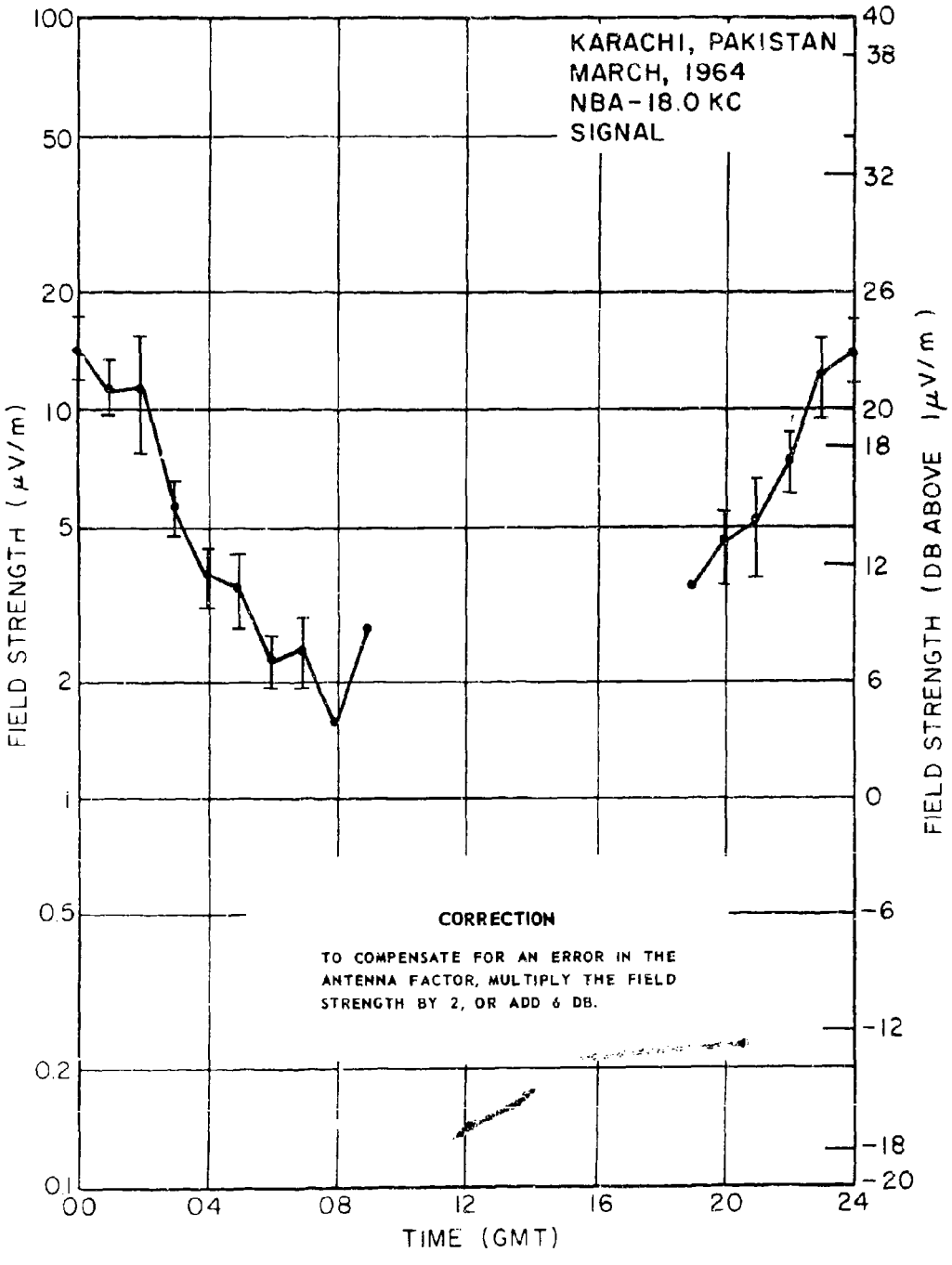
KARACHI, PAKISTAN
MARCH, 1964
NBA-18.0 KC
SIGNAL
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 94

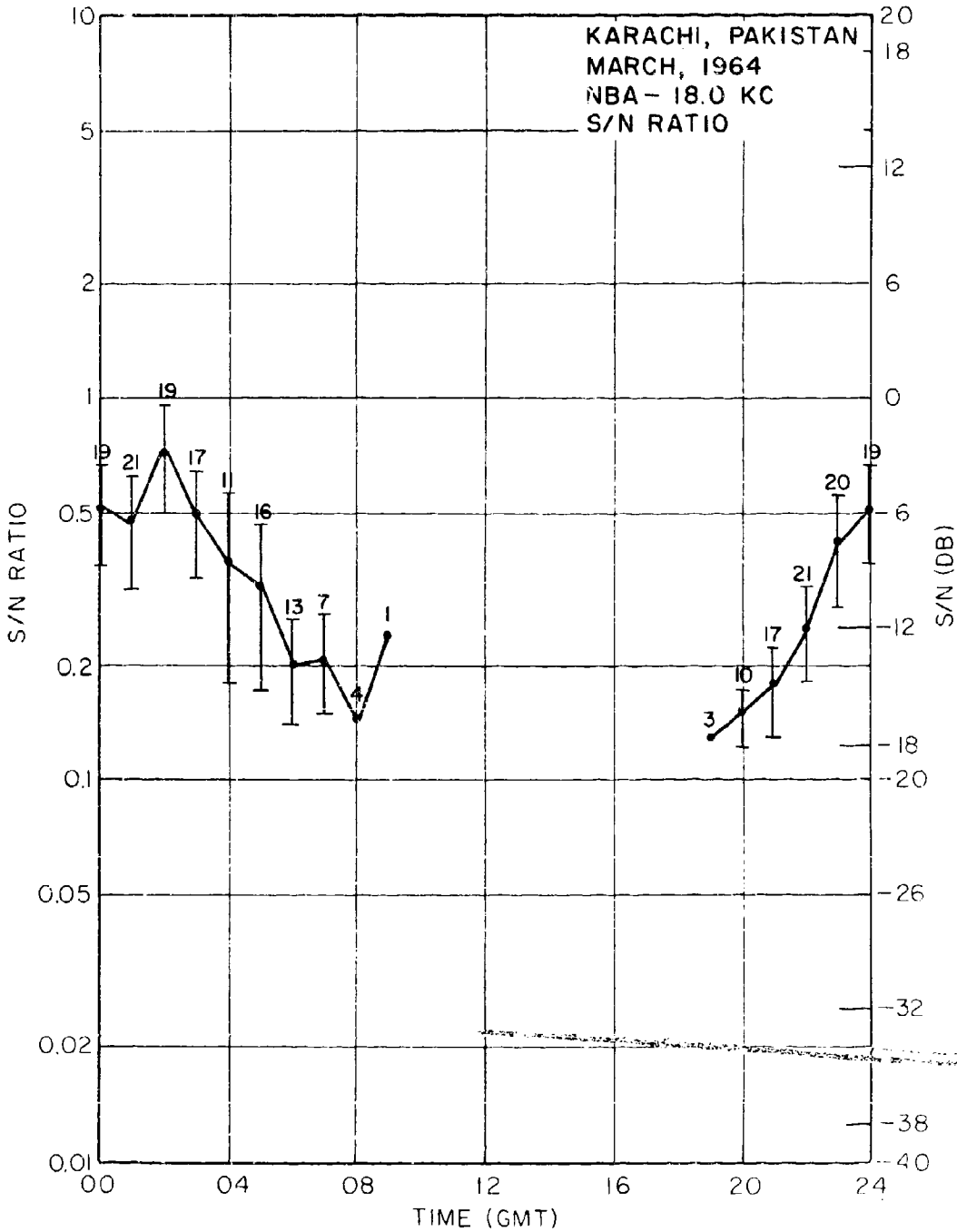
KARACHI, PAKISTAN
MARCH, 1964
NBA – 18.0 KC
S/N RATIO
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24
19
21
19
17
11
16
13
7
4
1
3
10
17
21
20
19

Figure 95

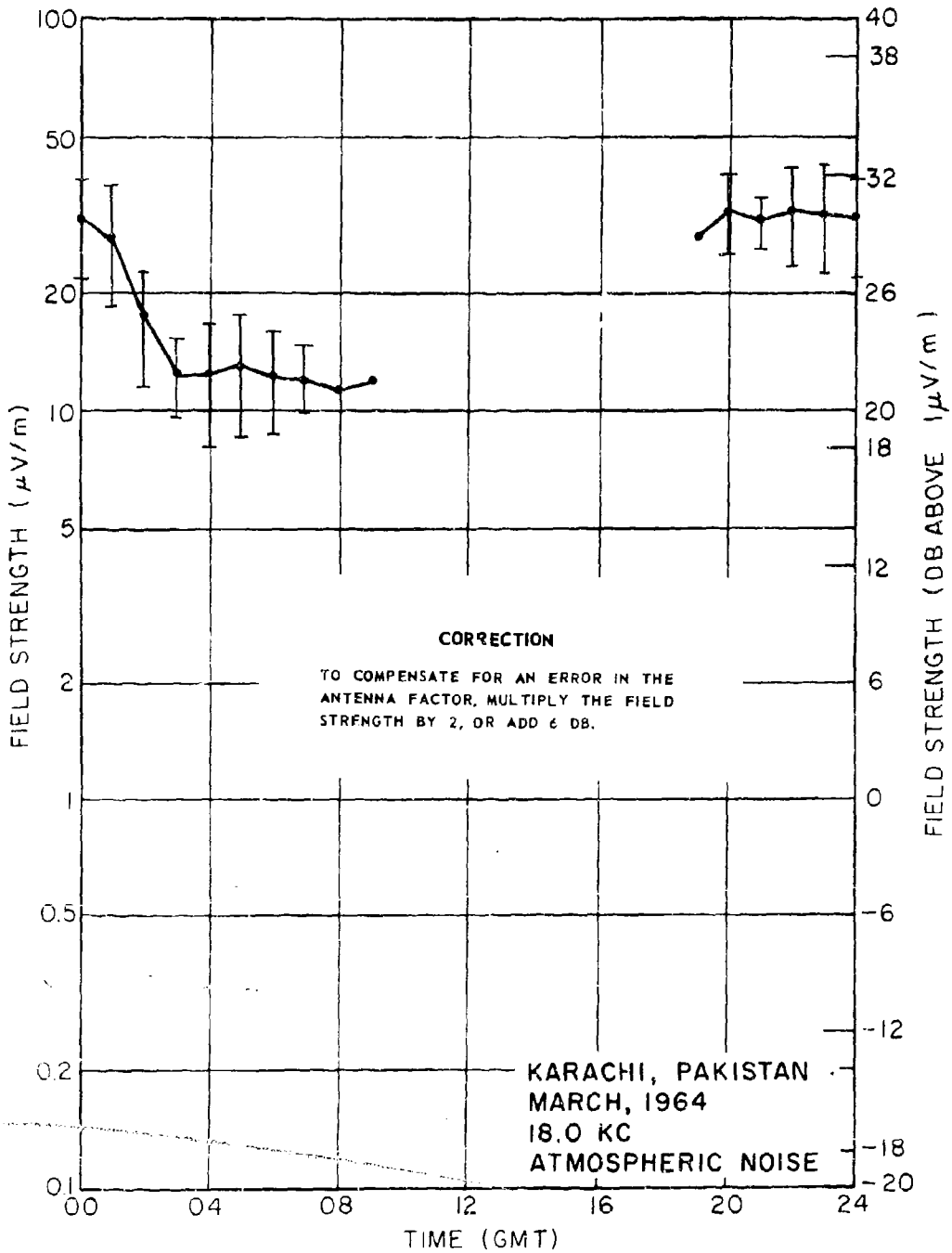
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
TIME (GMT)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.
KARACHI, PAKISTAN
MARCH, 1964
18.0 KC
ATMOSPHERIC NOISE

Figure 96

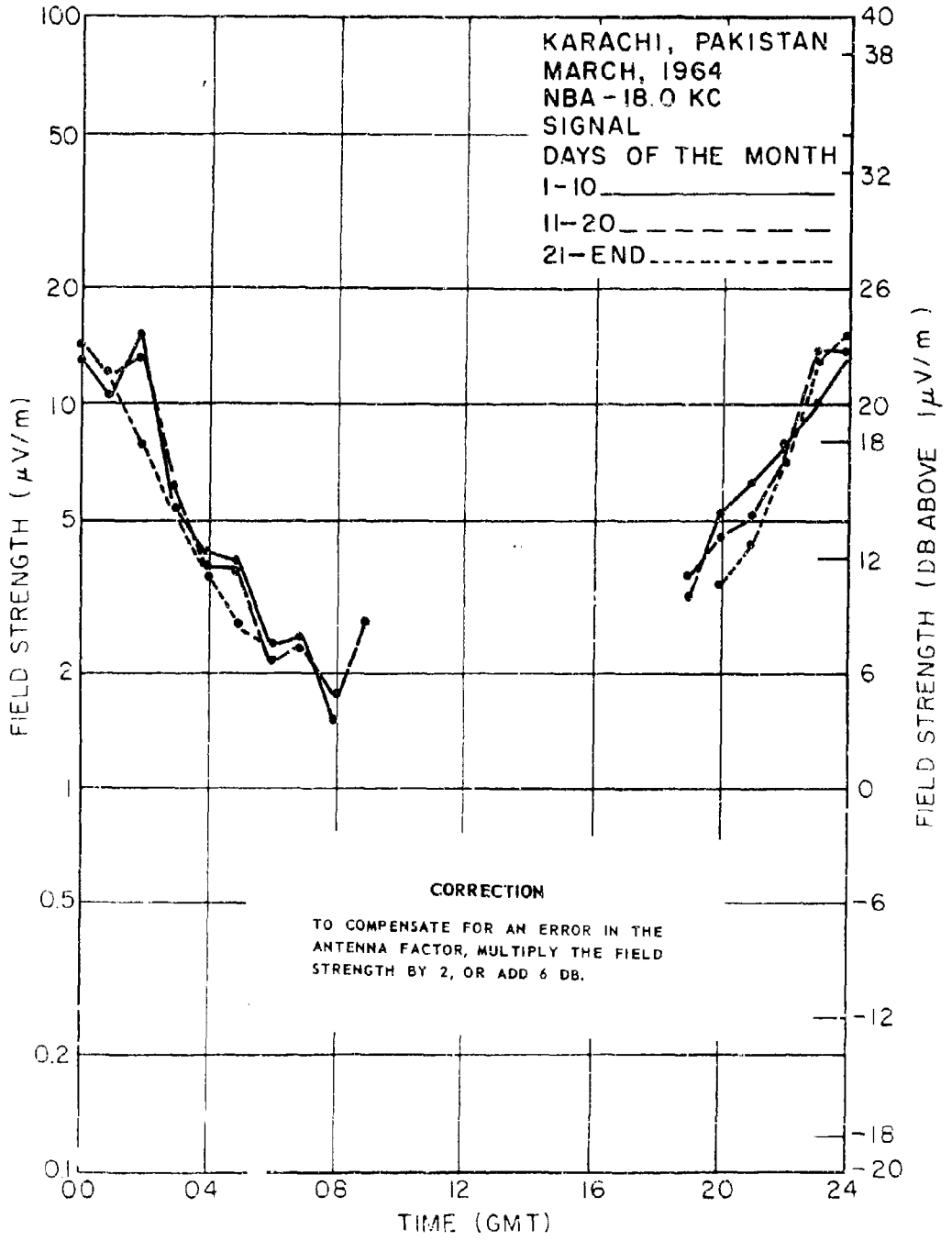
KARACHI, PAKISTAN
MARCH, 1964
NBA - 18.0 KC
SIGNAL
DAYS OF THE MONTH
1-10
11-20
21-END
FIELD STRENGTH (μV/m)
FIELD STRENGTH (DB ABOVE 1μV/m)
100
50
20
10
5
2
1
0.5
0.2
0.1
40
38
32
26
20
18
12
6
0
-6
-12
-18
-20
00
04
08
12
16
20
24
TIME (GMT)
CORRECTION
TO COMPENSATE FOR AN ERROR IN THE ANTENNA FACTOR, MULTIPLY THE FIELD STRENGTH BY 2, OR ADD 6 DB.

Figure 97

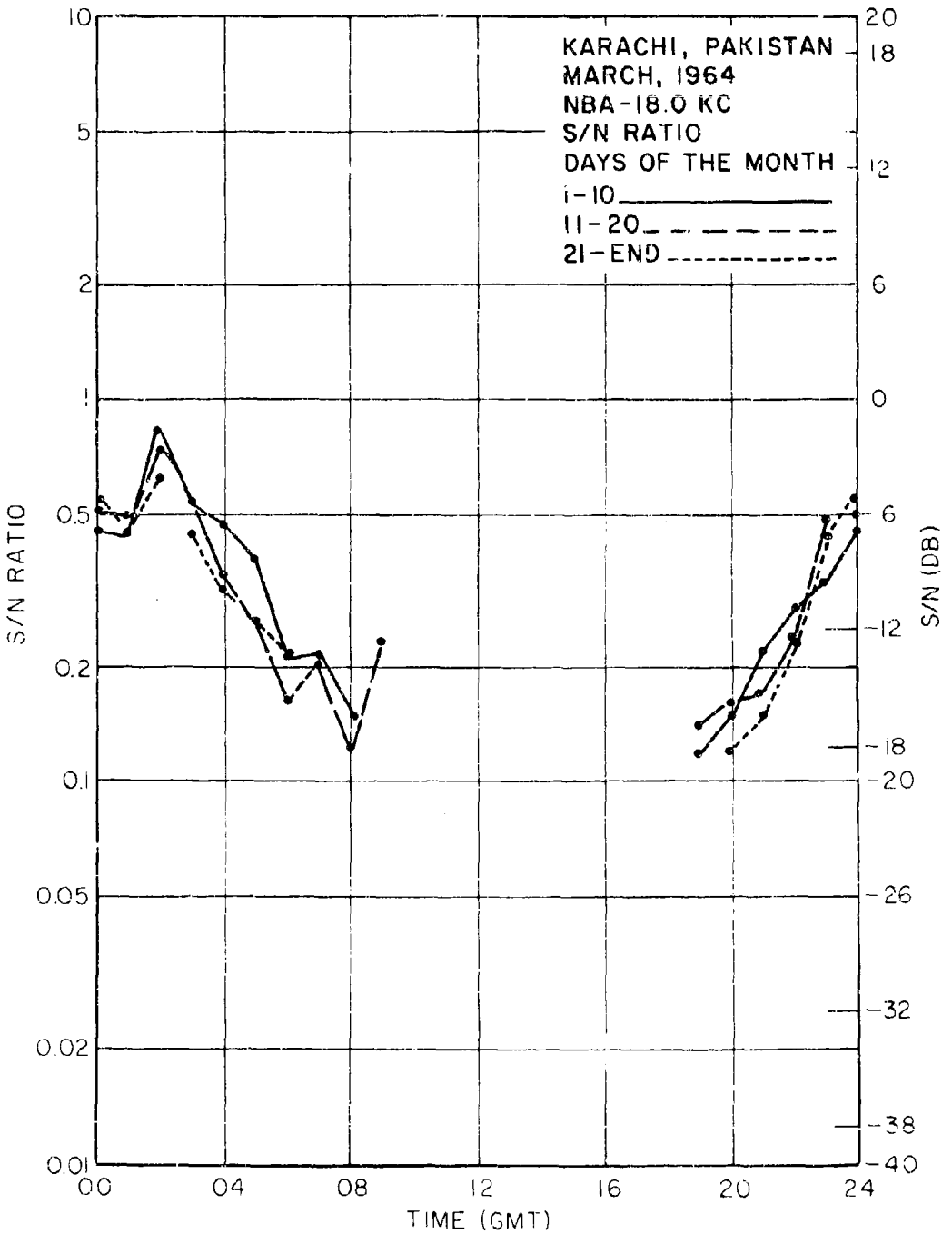
KARACHI, PAKISTAN
MARCH, 1964
NBA-18.0 KC
S/N RATIO
DAYS OF THE MONTH
1-10
11-20
21-END
S/N RATIO
S/N (DB)
TIME (GMT)
10
5
2
1
0.5
0.2
0.1
0.05
0.02
0.01
20
18
12
6
0
-6
-12
-18
-20
-26
-32
-38
-40
00
04
08
12
16
20
24

Figure 98

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-- 1 OF 1
-- 1 - AD NUMBER: 366153
-- 2 - FIELDS AND GROUPS: 20/14
-- 3 - ENTRY CLASSIFICATION: UNCLASSIFIED
-- 5 - CORPORATE AUTHOR: NAVAL RESEARCH LAB WASHINGTON D C
-- 6 - UNCLASSIFIED TITLE: FIELD STRENGTHS OF SOME VLF TRANSMISSIONS
-- AND ATMOSPHERIC NOISE MEASURED IN ASIA, JUNE 1963 THROUGH MARCH
-- 1964.
-- 8 - TITLE CLASSIFICATION: UNCLASSIFIED
-- 9 - DESCRIPTIVE NOTE: QUARTERLY REPT. NO. 15, JUN 63-MAR 64,
--10 - PERSONAL AUTHORS: GARNER,W. E.;RHOADS,F. J.;SCHAUER,R. L.;
--11 - REPORT DATE: 13 JUL 1965
--12 - PAGINATION: XXXXXX MEDIA COST: $ 7.00 PRICE CODE: AA
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--16 - PROJECT NUMBER: SR008 01 01 7028
--20 - REPORT CLASSIFICATION: [redacted]
--23 - DESCRIPTORS: (*RADIO TRANSMISSION, VERY LOW FREQUENCY), RADIO
-- WAVES, IONOSPHERIC PROPAGATION, ATTENUATION, NOISE(RADIO), SIGNAL-
-- TO-NOISE RATIO, MEASUREMENT, EXPERIMENTAL DATA, TABLES(DATA), ASIA
--24 - DESCRIPTOR CLASSIFICATION: UNCLASSIFIED
--29 - INITIAL INVENTORY: 20
--30 - ANNOTATION: FIELD STRENGTHS OF SOME VLF TRANSMISSIONS AND
-- ATMOSPHERIC NOISE MEASURED IN ASIA JUNE 1963 THROUGH MARCH 1964.

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--32 - REGRADE CATEGORY: C
--33 - LIMITATION CODES: 9
--34 - SOURCE SERIES: 15
--35 - SOURCE CODE: 251950
--36 - ITEM LOCATION: DTIC
--38 - DECLASSIFICATION DATE: OADR
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--41 - TYPE CODE: N
--43 - IAC DOCUMENT TYPE: